4 FINANCIAL AND ECONOMIC REVIEW

December 2018
Vol. 17 Issue 4

Business, Housing, and Credit Cycles – The Case of Hungary
Eyno Rots

Capital Market Contagion in the Stock Markets of Visegrád Countries Based on the Heckman Selection Model
Máté Csiki – Gábor Dávid Kiss

An Analysis of the Payment Habits of Hungarian Micro, Small and Medium-sized Enterprises – In Focus: Cash Usage
Ágnes Illés Belházy – Tamás Végső – Anikó Bódi-Schubert

Depositors' Behaviour in Times of Mass Deposit Withdrawals
Hubert János Kiss

Monitoring of Banks' Risks Related to the Funding of Financial Enterprises
György Inzelt – Zsuzsa Szentes-Markhot – Gábor Budai

Financial and Economic Review

Scientific journal of the Magyar Nemzeti Bank

Publisher: Magyar Nemzeti Bank
Publisher in Charge: ESZTER HERGÁR
H-1054 Budapest, Szabadság tér 9.
www.hitelintezetiszemle.hu
ISSN 2415–9271 (Print)
ISSN 2415–928X (Online)

Cover design: MARIANNA IZSÓNÉ BIGAI

4 FINANCIAL AND ECONOMIC REVIEW

December 2018
Vol. 17 Issue 4

FINANCIAL AND ECONOMIC REVIEW

The address of the Editorial Office: H-1054 Budapest, Szabadság tér 9.

Phone: +36-1-428-2600

Fax: +36-1-429-8000

Homepage: www.hitelintezetiszemle.hu

E-mail: szemle@hitelintezetiszemle.hu

Editorial Staff:

Barnabás Virág Editor-in-Chief, E-mail: viragb@mnb.hu

Endre Morvay Editor-in-Charge, E-mail: morvaye@mnb.hu

Published regularly in every three months.
HU ISSN 2415–9271 (Print)
HU ISSN 2415–928X (Online)

Page setting and printing:
Pauker – Prospektus – SPL consortium
H-8200 Veszprém, Tartu u. 6.

Contents

Vol. 17 Issue 4, December 2018

STUDIES

Eyno Rots:
Business, Housing, and Credit Cycles – The Case of Hungary 5

Máté Csiki – Gábor Dávid Kiss:
Capital Market Contagion in the Stock Markets of Visegrád Countries Based on the Heckman Selection Model 23

Ágnes Illés Belházy – Tamás Végső – Anikó Bódi-Schubert:
An Analysis of the Payment Habits of Hungarian Micro, Small and Medium-sized Enterprises – In Focus: Cash Usage 53

Hubert János Kiss:
Depositors' Behaviour in Times of Mass Deposit Withdrawals 95

György Inzelt – Zsuzsa Szentes-Markhot – Gábor Budai:
Monitoring of Banks' Risks Related to the Funding of Financial Enterprises 112

BOOK REVIEWS

Pál Péter Kolozsi:
Time To Look at the State in a Different Way – Value Creation and Innovation in the 21st Century
(Mariana Mazzucato: The Value of Everything: Making and Taking in the Global Economy) 140

Alexandr Maxim Palicz:
Alternatives for Europe's Future
(Joseph E. Stiglitz: The Euro: How a Common Currency Threatens the Future of Europe) 146

Kitti Vajda:
A World Without Jobs
(Martin Ford: Rise of the Robots: Technology and the Threat of a Jobless Future) 152

CONFERENCE REPORTS

Ferenc Tóth – András Zsolt Szabics – Gábor Szarka:
Report on the Sessions of the Finance, Competitiveness and Responsible Corporate Governance Sections of the Annual Congress of the Hungarian Economic Association in 2018 155

Business, Housing, and Credit Cycles – The Case of Hungary*

Eyno Rots

This paper studies the characteristics of financial cycles in Hungary. It applies existing methodology from the literature to Hungarian data to estimate a multivariate structural time-series model. The model allows for a joint examination of the behaviour of the Hungarian financial sector and the overall economy, and estimates their cyclical positions. According to the results of the estimation, the financial sector in Hungary seems to experience volatile cycles, which last more than 15 years on average. Moreover, the cyclical position of output seems to show strong co-movement with the long financial-sector cycles. Although the data series available for Hungary are relatively short, the results of the estimation are quite credible, since they conform to the existing international evidence and seem robust to even stricter data limitations.

Journal of Economic Literature (JEL) codes: C32, E32, E44

Keywords: time-series models, financial cycles, real business cycles, house prices, MLE

1. Introduction

In the wake of the global financial crisis, economists have been paying considerable attention to macro-financial linkages. There is now a large body of empirical literature that provides conclusive evidence on the link between the financial and the real side of the economy. For example, *Reinhart and Rogoff* (*2009*) studied recessions around the world using over 800 years of data and find that they are particularly severe when they are accompanied by banking crises or rapid contractions of lending activity. *Schularick and Taylor* (*2012*) also conducted a study of crises based on long historical data and find that credit growth is a powerful predictor of a financial crisis; moreover, the ensuing recession tends to be more severe when the credit growth is rapid. Given this evidence, tracking developments in the financial sector and protecting its stability have become an important part of

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Eyno Rots is a Senior Economic Researcher at the Magyar Nemzeti Bank. E-mail: rotse@mnb.hu

The English manuscript was received on 27 April 2018.

DOI: http://doi.org/10.25201/FER.17.4.522

many policymakers' mandate. For the sake of an effective macroprudential policy, it has become necessary to evaluate the current state of the financial sector and its future prospects in an accurate and timely manner.

It has become evident that an economy's financial sector activity, which can be measured by such variables as the aggregate credit volume, is subject to cyclical fluctuations. The financial sector tends to experience periods of expansion, accompanied by rising leverage, increasingly risky profit-seeking behaviour, looser lending standards, etc. Periods of expansion are followed by contractions, which may occur as financial crises, when financial institutions rapidly de-leverage and cause a collapse of the credit supply. Recent research (see *Drehmann et al. 2012*, *Aikman et al. 2015*, *Galati et al. 2016*, *Rünstler et al. 2018*) has revealed that, in many countries in Europe and elsewhere, financial cycles are longer and larger than the typical business cycles, which are believed to manifest themselves through such variables as GDP and its components, inflation and unemployment. One popular way to examine the cyclical financial sector activity is to pool data from several sources and conduct multivariate estimations. For example, house prices can serve as a good source of information on financial cycles, along with measures of credit. There are various feedback loops between residential prices and credit aggregates, which mainly operate through the market for mortgages. For example, higher housing demand increases house prices and makes it necessary for households to take out larger mortgages in order to be able to afford housing. Higher house prices also result in a higher value of collateral available to back mortgages. Vice versa, a stronger supply of credit may boost mortgage lending and increase demand for housing. A recent example of an empirical study that jointly considers credit, house prices and GDP to extract cyclical components of these series is *Rünstler and Vlekke* (*2018*). They estimate a multivariate structural time-series model (STSM) using the data from the US and several European countries and find evidence of long and volatile financial cycles there.

The goal of this paper is to confirm the presence of long and volatile financial cycles in Hungary. It follows *Rünstler and Vlekke* (*2018*) and performs an analogous estimation for Hungarian data on GDP, total banking credit extended to private firms and households, and the house price index developed by the Magyar Nemzeti Bank (MNB). The findings conform to the evidence from other countries. Namely, the financial series (credit and house prices) exhibit long cycles, which average 14–16 years in length. Moreover, the estimation of the multivariate model reveals that the GDP series also shows pronounced medium-term fluctuations, which average about 15 years and are longer than what can be called "real business cycles". The GDP cycles tend to comove with the financial cycles – the coherence between the two types of series is especially evident over medium-term frequencies, which are lower than business-cycle frequencies. The connection existing between the cyclical

positions of output and the financial series provides an argument for coordination between monetary and macroprudential policies. Finally, the estimation results show that the multivariate approach can provide real-time estimates that are much more accurate than univariate filters (such as the Christiano-Fitzgerald filter, for example), which means that policymakers should rely on several sources of information in order to make an accurate and timely evaluation of the cyclical position of the financial sector.

This work is by no means the first to look at cyclical developments in the Hungarian financial sector. In recent years, there has been keen interest in the assessment of financial cycles in Hungary, following the repercussions of the global financial crisis and the establishment of a comprehensive macroprudential policy framework by the Magyar Nemzeti Bank (the central bank of Hungary). Several empirical studies have provided estimates of the cyclical positions of the series related to the financial sector. Compared to the existing empirical research, the key contribution of the present work is that, to the best of my knowledge, it takes a first look at the *empirical regularities* of the cycles that are exhibited by the Hungarian financial sector data.

Hosszú et al. (*2015*) compare the ability of different filtering methods to evaluate the cyclical position of the Hungarian credit-to-GDP ratio. Between the multivariate Hodrick-Prescott (HP) filter and a set of standard univariate filters, such as Christiano-Fitzgerald, Beveridge-Nelson, and univariate HP filter, they favour the multivariate model, which tends to provide more accurate real-time estimates. Motivated by this finding, *Kocsis and Sallay* (*2018*) use a modification of the multivariate HP filter to decompose the credit-to-GDP ratio into the unobserved cyclical and trend components. However, the authors do not estimate the cycle length. To extract a trend, they assume a value of the smoothing parameter of the HP filter, which is based on the empirical observation from the literature that financial cycles tend to be about four times as long as business cycles. On the contrary, the current work does not make such assumptions, as its goal is precisely to establish the empirical facts about the Hungarian financial cycles, including their length. Still, it conforms to *Hosszú et al.* (*2015*) and *Kocsis and Sallay* (*2018*) in the sense that it relies on a multivariate model to evaluate the financial cycles, although the model is different.

Banai et al. (*2017*) constructed a Hungarian house price index using the hedonic-regression approach. It covers the widest available data on housing market transactions, and it allows the national house-price level to be tracked back to 1990. Using this index, *Berki and Szendrei* (*2017*) estimate a vector error-correction model, which establishes a co-integrating relationship between the house price index and measures of household income, housing stock and credit supply. As a result, they are able to find the equilibrium level of the house price justified

by housing market fundamentals, and establish a stationary, cyclical movement of the actual house price around the equilibrium. Strictly speaking, this method is not a pure trend-cycle decomposition, because the equilibrium house price is determined by fundamentals, which experience cyclical movement of their own. Moreover, the authors do not focus on the general properties of housing market cycles, or the financial sector more generally. Nevertheless, they do point out that the housing market gap is persistent, and that the volatility of the gap might be underestimated.

Before I describe the estimation and results, one important remark is in order. To study financial cycles, it is desirable to obtain long time series. Hungarian data, however, are only available from the early 1990s. Therefore, it is with extreme caution that we can make any judgement on the features of Hungarian financial cycles. Less than three decades of data are available, whereas international evidence suggests that these cycles may last up to 15–20 years. With this limitation in mind, I invite the reader to treat this work as an early look at the Hungarian financial cycles.

2. Methodology

The goal of the study is to use the method of *Rünstler and Vlekke* (*2018*)[1] and apply it to the Hungarian data. This method allows for the study of the cyclical behaviour of Hungary's economy and the financial sector together, as opposed to empirical approaches that look at real business cycles and financial cycles separately. To study several data sources jointly seems appropriate, especially because the Hungarian data series are rather short. In addition, in order to cope with the problem of limited data, the results of the estimation of Hungarian cycles are cross-checked against the results reported by Rünstler and Vlekke for the US and several European economies. For the purposes of the estimation, the dynamics of GDP, credit volume and house prices can be jointly decomposed according to the following multivariate structural time-series model (STSM):

$$x_t = \mu_t + x_t^c + \varepsilon_t, \tag{1}$$

where x_t is a vector that contains the values of the three variables observed in a quarter t, x_t^c is its cyclical component, μ_t is a trend component, and $\varepsilon_t \sim N(0, \Sigma_\varepsilon)$ is a vector of independent and identically distributed errors. I refer the reader to the original paper (*Rünstler and Vlekke 2018*) for the details of the specification. Importantly, the cyclical component is a linear combination of n cycles:

$$x_t^c = \tilde{A}\tilde{\psi}_t, \tag{2}$$

[1] It is an extended version of the multivariate structural time-series model (STSM) due to Harvey and Koopman (1997)

where $\tilde{A}$ is a matrix, and $\tilde{\psi}_t$ is a stack of *n* cycles. Each cycle $\tilde{\psi}_{it}, i \in \{1,...,n\}$, is a stationary stochastic process, which is determined by a combination of cyclic trigonometric functions:

$$(1-\phi_i)\tilde{\psi}_{it} = (1-\phi_i)\rho_i \begin{bmatrix} \cos\lambda_i & \sin\lambda_i \\ -\sin\lambda_i & \cos\lambda_i \end{bmatrix} \tilde{\psi}_{it-1} + \tilde{\kappa}_{it}. \quad (3)$$

In this formulation, $\tilde{\psi}_{it}$ is a *2 x 1* vector that summarises a cycle; λ_i is a parameter that determines the frequency of the cycle; ρ_i is the cycle-dampening auto-regressive coefficient (high value of ρ_i corresponds to well-pronounced cycles of frequency λ_i); ϕ_i is an auto-regressive coefficient that is introduced in addition to ρ_i in order to make the model capable of capturing the persistence of financial cycles observed in the data.

The presented model specifies the cyclical behaviour of each of the observed variables as a combination of *n* cosine waves of various frequencies and with different phase shifts. The model's structure makes it possible to convert the estimates of the model's parameters into the measures of each variable's cyclical volatility and persistence, as well as phase shifts and coherences between the three variables over various frequency ranges. I report these estimates in the results section. Note that the specification of the model described by equations (1)–(3) allows for an arbitrary number of cycles *n*. I use the model with three cycles: *n = 3*. However, the maximum-likelihood estimation over the Hungarian data has revealed preference for the specification in which two out of three cycles of the cyclical component x_t^c are restricted to have the same parameterisation $\{\lambda_i, \phi_i, \rho_i\}$, so that there are cycles of two kinds that characterise the cyclical behaviour of the observed variables. Likelihood-ratio tests failed to show that allowing for three different cycles significantly improves the empirical fit of the model, whereas a more restricted model with one cycle parametrisation performs significantly worse. Therefore, I report the results obtained from a multivariate model with two different types of cycles. Intuitively, the fluctuation of each of the observed series around a trend is specified as a combination of unobserved processes that are cyclical in nature, and that have different frequencies of the cycles.

As for the trend component μ_t, its growth rate is driven by a combination of permanent (slope) and transitory (level) shocks:

$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t, \quad \eta_t \sim N(0, \Sigma_\eta) \quad (4)$$

$$\beta_t = \beta_{t-1} + \zeta_t, \quad \zeta_t \sim N(0, \Sigma_\zeta) \quad (5)$$

The *3 x 1* vector μ_t defines trends for the three observed variables, and independent normally-distributed shocks η_t and ζ_t are characterised by the *3 x 3* variance-covariance matrices Σ_η and Σ_ζ. For comparability of the results with the literature, I restrict the slope innovation for each of the three variables as an independent shock (which corresponds to a diagonal variance-covariance matrix Σ_ζ). Moreover, for credit and house price, I fix the standard deviation of the slope innovation at $\sigma_\zeta = 0.005$,[2] which accounts for the fact that the financial sector in Hungary, as measured through credit volumes and house prices, arguably has experienced volatile trend dynamics since the transition to a market-based economy.[3]

In order to estimate the model, I cast the model in its state-space form and therefore make it possible to implement the Kalman filter and compute the likelihood function for a certain parameterisation of the model given the observed data. I rely on Newton-based numerical methods to maximise the likelihood function and find the maximum-likelihood estimates of the model's parameters and the corresponding measures of the cyclical behaviour of the observed variables.

The performance of the multivariate model is also compared against the set of three univariate models (one individual cycle independently estimated for each of the variables). Technically, the difference between the two cases is whether the non-diagonal elements of matrix $\tilde{A}$ in equation (2) are restricted to be zero (in case of univariate models) or not. Unlike the set of univariate models, a multivariate model allows the possibility of interactions between the cyclical components of the variables under consideration. In terms of the achieved values of the likelihood function, the multivariate model, in which cycles jointly determine the cyclical behaviour of all three variables, performs significantly better than a stack of three univariate models. I therefore focus on reporting the results for the multivariate model below.

3. Results

I obtain quarterly Hungarian data that spans 1990q1–2018q1 and includes real GDP, aggregate credit volume extended by domestic banks to the private sector, and the MNB house price index.[4] As already noted, the data series available for Hungary are less than 30 years long; it is quite an audacious task to rely on such short data series to judge about the empirical features of financial cycles that are likely to last longer than 15 years. Nevertheless, the results obtained for Hungary are in line with the findings for other European countries reported in the existing

[2] *Rünstler and Vlekke* (*2018*) set the values between 0.001 and 0.0025.
[3] For example, see *Berki and Szendrei* (*2017*).
[4] All data are adjusted for inflation and seasonally, where necessary. Sources: BIS, Eurostat, MNB, KSH.

literature and qualitatively robust to even stricter data limitations, which definitely adds some credibility to the findings reported below.

The estimation of the multivariate model with two cycles suggests that the cyclical behaviour of the observed series is driven by cycles with average lengths of 2.8 and 19.4 years. However, the average length of each individual cycle $\tilde{\psi}_{it}$ is difficult to interpret: according to equation (2), the cyclical component of each of the observed variables is a linear combination of the two cycles. For this reason, instead of the individual cycles and their parameter values, I report the results in terms of the combined cyclical behaviour of the observed variables, such as average cycle length, volatility, etc.

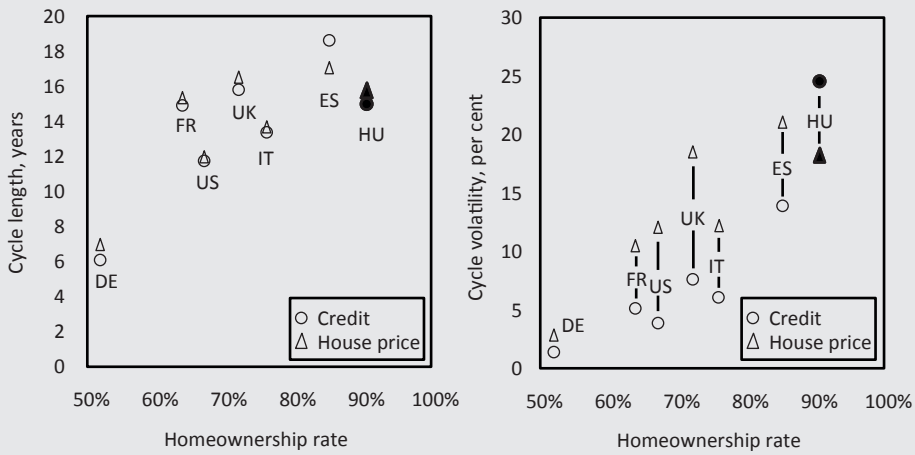
Table 1
Cyclical properties of the observed variables in Hungary

	Variable		
	Y_t	C_t	P_t
Cycle length, years	16.940	15.091	15.693
Cycle volatility, per cent	8.612	20.052	18.261

Note: Cyclical properties of the observed variables: GDP (Y_t), credit (C_t) and house price (P_t). The table shows estimates of the average length and the standard deviation of the cycles observed in each of the three variables. These values are obtained using the multivariate spectral generating function from the estimates of the parameters that characterise the cyclical component of the model.

Table 1 reports the average cyclical behaviour of the GDP (Y_t), the volume of credit (C_t) and the house price (P_t) estimated for Hungary. The house-price and credit cycles are estimated to last 15–16 years and be 2–2.5 times as volatile as the output cycles. The standard deviation is estimated to be 18.3 per cent for the house price cycles and 20.1 per cent for the credit cycles, whereas for the GDP cycles it is 8.6 per cent. As already mentioned, the estimated length of the cycles is large compared to the length of the available data, which may raise doubts about the quantitative precision of the findings. However, as discussed in *section 4.2* below, an estimation over a much shorter data set delivers results that are qualitatively very similar for Hungary, which is reassuring for the validity of the findings.

Figure 1
Homeownership and financial cycles



Note: Relationship between the homeownership rate and the cyclical behaviour of the house price and the credit volume. Estimates for Hungary (black marks) are added to the existing estimates of Rünstler and Vlekke (2018) for other European countries and the US.

It is also somewhat reassuring that the presented findings are in line with the existing empirical evidence. For Hungary, a good reference would be the evidence from CEE countries, which, unfortunately, is limited. For example, *Gonzalez et al.* (*2015*) try to estimate the length of credit and business cycles in 28 countries, but for the CEE countries in their sample (Czech Republic, Hungary, Poland), they are unable to find evidence of long cycles, which is due to the fact that the available data series are short for these countries. *Communale* (*2017*) does report that house price and credit cycles are more volatile than the GDP cycles in Estonia, Croatia, Hungary, Latvia, Lithuania, and Slovenia, but does not report the cycle durations.

Nevertheless, evidence from other countries suggests the presence of financial cycles that are generally longer than the business cycles, which are typically assumed to last 2–8 years, and much more volatile. *Rünstler and Vlekke* (*2018*) estimate the cyclical behaviour of GDP, credit, and house price for several European countries and the US: in all countries but Germany, they find that the financial series exhibit cycles that are much longer than the output cycles, and last between 11.8 and 18.7 years on average. As for Germany, its financial series feature short cycles, which fall within the business-cycle range, and which are about as volatile as the cyclical fluctuations of GDP. Interestingly, the authors also report that countries with higher homeownership rates tend to have longer and more volatile financial cycles. A potential reason for this relationship may be that high homeownership

rate is a symptom of low liquidity of the housing market,[5] which results in sluggishness of house price dynamics and, through the relationship between the markets for housing and mortgages, of the credit-volume dynamics. Regardless of the explanation, Germany seems to follow this pattern, since it is a country with a very low homeownership rate, which was at only 52 per cent on average between 1995 and 2013. In *Figure 1*, I augment the data from Rünstler and Vlekke with the Hungarian numbers: it appears that these numbers fit the general picture. The Hungarian house price and credit cycles seem to be comparatively long and volatile, but the Hungarian homeownership rate is also the highest among the reported economies: according to the population surveys conducted by the country's Central Statistical Office (Központi Statisztikai Hivatal, KSH) in the last decade, over 90 per cent of the households own the dwellings where they live.

Speaking about the GDP cycles, *Table 1* shows them to be quite long in general. In line with the aforementioned empirical literature, the Hungarian GDP cycles also tend to be longer than what is typically believed to be the business-cycle range of 2–8 years. They are estimated to last 16.9 years on average. This empirical finding is difficult to establish by means of the commonly used univariate Hodrick-Prescott, Baxter-King, and Christiano-Fitzgerald filters. These filters require an assumption about the plausible range of cyclical frequencies in order to extract the cyclical component. Naturally, if the initial assumption is that the cyclical component only includes cycles that last 2–8 years, it is impossible to extract cycles with lower frequencies from the data. So, the first limitation of the aforementioned filters is that they depend on such an assumption. The second limitation is that they only consider the series individually. Given that the available data series are often rather short, it may be difficult to identify low-frequency cycles from such data series, even if the researcher has no prior assumptions about the plausible cycle length. When the cycle length is sizable compared to the length of the available data series, it may be necessary to pool several data series together in order to discover such a cycle. By looking at the dynamics of GDP together with house price and credit volume, it is possible to uncover medium-term fluctuations. These fluctuations occur at frequencies that are lower than the frequencies of the real business cycles, the traditionally assumed domain of GDP. In addition, by looking at the data jointly, it is possible to establish a high degree of comovement between the medium-term GDP and financial cycles.

[5] For example, buy-to-let landlords are generally trading properties more frequently; therefore, high homeownership rate corresponds to fewer trades for the same amount of housing stock, since fewer houses are bought to rent.

Table 2
Coherence between cyclical components in Hungary

	Y_t, C_t	Y_t, P_t	C_t, P_t
Total	0.851	0.245	0.371
8–32 quarters	0.461	0.128	0.352
32–120 quarters	0.891	0.257	0.379

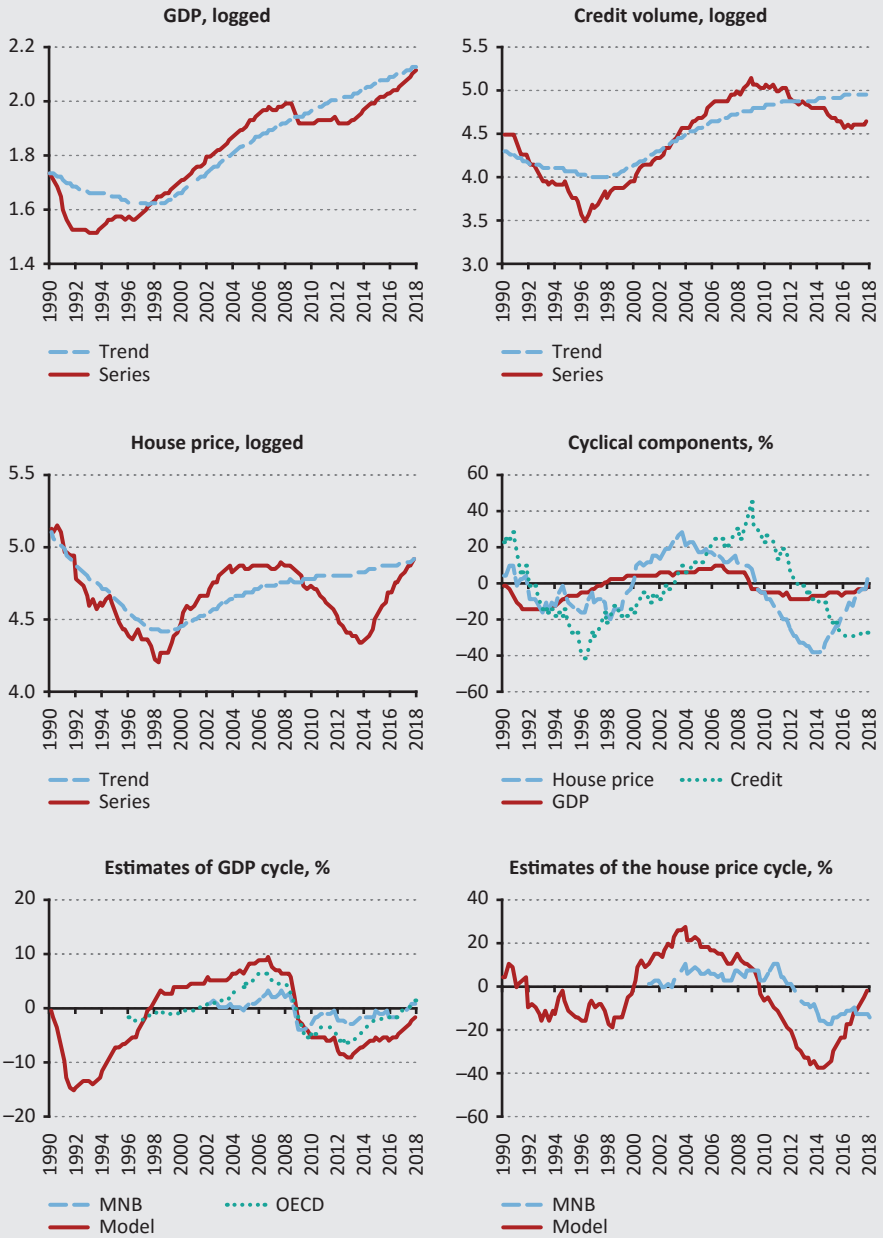
Note: Coherence between the cyclical components of the observed variables: GDP (Y_t), credit (C_t) and house price (P_t).

Table 2 shows pairwise coherences between the three observed variables, which is the counterpart of correlation that is computed over the frequency domain using spectral analysis: it allows us to check over which frequencies (or which cycle lengths) the variables exhibit the greatest comovement. The close connection between the financial cycles and GDP is evident for the credit volume: while the coherence between GDP and house price is 0.245, it is as high as 0.851 between GDP and credit. Moreover, the financial variables seem to have stronger coherence with GDP in the medium term rather than the short term. Coherence over cycles lasting 8–32 quarters is estimated to be 0.461 between GDP and credit and 0.128 between GDP and house price, while the corresponding figures for medium-term frequencies, or cycles lasting 32–120 quarters, are 0.891 and 0.257.

Figure 2 demonstrates estimated cyclical components of GDP, credit volume and house price. The cyclical components panel shows the cycles for the three variables together. It is evident that within the multivariate STSM that is estimated for Hungary, there is visible comovement between the GDP cycles and the financial cycles (summarised by the other two variables). The cyclical position of GDP shows persistence, and it generally maintains the same sign and similar changes as the cycles of the financial variables. The last two panels of *Figure 2* compare the cyclical positions of GDP and house prices estimated using the multivariate STSM with the official, publicly-available estimates. The GDP panel compares the GDP cycle with the quarterly estimates of the output gap provided by the MNB (data available from 2002) and with the annual data for the output gap provided by the OECD (available from 1996).[6] According to the estimated model, the output gap was persistently positive in Hungary before 2008, when the global financial crisis unfolded and the gap turned negative. This timeline is very similar to the official figures. Unlike the official data, however, the estimates from the STSM indicate that the output gap still remained negative at the end of 2017, although it had been consistently shrinking since 2012. Overall, the model's estimates of the output gap are qualitatively similar to the official estimates.

[6] OECD annual data are interpolated in order to obtain quarterly figures.

Figure 2
Cyclical positions of GDP, house price and credit in Hungary



Note: Estimates obtained from the model: logged series compared with trends, and cyclical components as percentage-deviations from trends. Estimated cyclical components of the GDP and the house price are compared with the official data from the MNB and OECD.

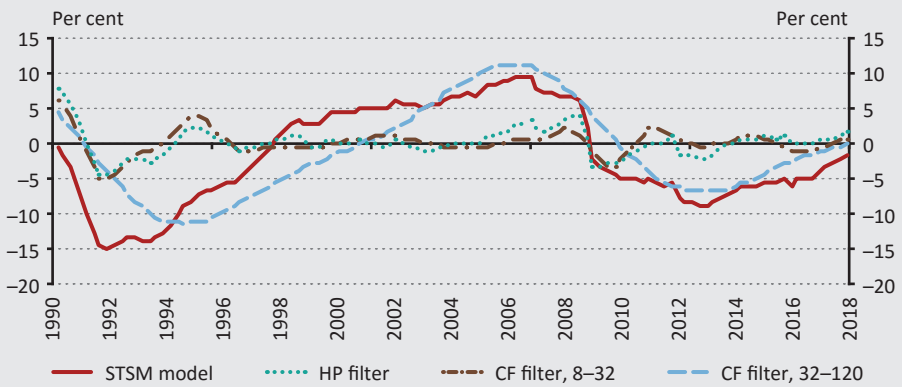
There are more visible deviations concerning the size and the sign of the estimated house price cycle when it is compared with MNB's estimate of the deviation of the house price index from the level "justified by the macroeconomic fundamentals"[7]. The reason for that seems to be the fact that the trend estimated by the STSM does not account for fundamentals. For example, the STSM is able to capture a long period of house price decline in the 1990s as a trend development, which seems to be the case: Hungary was undergoing a transition from a planned economy. The cyclical deviation is relatively moderate for that period. On the contrary, there was a period of house price growth around the early 2000s, which was in part due to rising income per capita, and in part due to the development of the mortgage market and introduction of mortgages subsidised by the government during that period. These developments can be captured as fundamental in the MNB's official estimates, resulting in a rising equilibrium house price and a smaller positive house price gap. At the same time, the STSM is likelier to treat the house price movement in the early 2000s as cyclical, which results in a larger cyclical deviation compared to the official estimates. Similarly, upon the outbreak of the 2008 crisis, there was a fall in household incomes, the emergence of non-performing mortgage loans, especially FX-denominated loans in the face of a weakening forint, and the ensuing tightening of lending conditions. These fundamental developments could be treated as a decrease in the equilibrium house price, which effectively postponed the time when the official price gap became negative, whereas the STSM model is likely to interpret these developments as cyclical and therefore predict an earlier change in the sign of the house price cycle. In light of these differences, it is arguable whether some of the events in the financial market, such as the development of a competitive mortgage market in the 2000s, should be viewed as permanent trend adjustments. At least part of such changes can be due to cyclical considerations – for example, it does not seem to be a coincidence that the development of the mortgage market had to take place during relatively tranquil times of credit-market expansion rather than during the financial crisis.[8]

Speaking about the discovered persistence of cycles, it is easy to miss this when employing popular univariate filters to extract cyclical dynamics. As an example, let us consider the estimates of the output gap. *Figure 3* compares the estimates of the GDP cycle from the multivariate STSM with the estimates obtained using popular univariate filters. The Christiano-Fitzgerald (CF) filter is a univariate band-pass filter, which requires that the researcher specify a frequency band, or a range of frequencies of cycles to be extracted from the time series. If I assume that the cyclical output fluctuations are between 8 and 32 quarters, as is typically done in the RBC literature, I am not able to find persistent GDP cycles. Similarly, the univariate Hodrick-Prescott filter with standard parameterisation for quarterly data ($\lambda = 1{,}600$) is designed so that it ignores low-frequency dynamics and produces an estimate of the GDP cycle that also

[7] Housing Market Report, November 2017, MNB.
[8] For a more detailed discussion of the developments in the Hungarian housing markets, see *Berki and Szendrei* (*2017*).

lacks persistence. By contrast, if I assume that GDP involves medium-term cycles that last between 32 and 120 quarters and run the CF filter with such band specification, I get an estimate that is much more similar to the estimate of the multivariate model.

Figure 3
Various estimates of the GDP gap in Hungary



Note: Estimates of the cyclical position of GDP obtained from the STSM model and compared with estimates based on standard univariate filters: Christiano-Fitzgerald filter (CF) with frequency band set between 8 and 32 quarters; CF filter with frequency band 32–120 quarters; Hodrick-Prescott (HP) filter with standard value of the smoothing parameter recommended for quarterly data: λ = 1,600.

4. Robustness checks

4.1. Precision of the real-time estimates

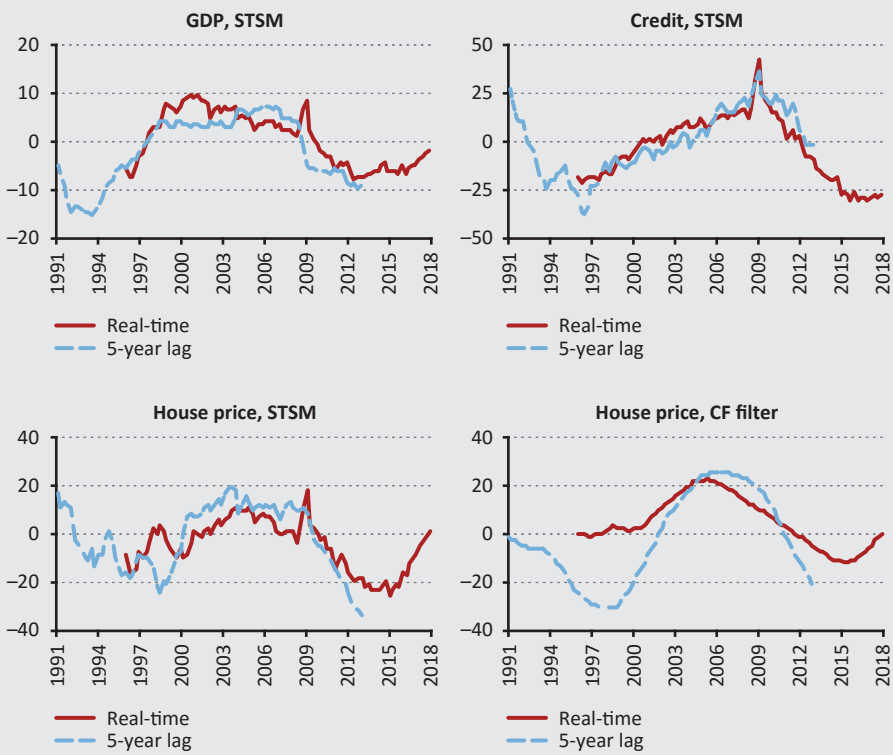
In the previous figures, all of the estimates of the cyclical positions of the observed variables are based on all of the available data. Looking ten years back, we can quite confidently say that, for example, the GDP gap was positive before the global financial crisis and turned negative during the crisis. However, it would be interesting to see if the same could be said just as confidently back in 2008, when the data was available only up to 2008. A policymaker does not have the benefit of hindsight and must judge about the state of the world based on current data.

To gauge the precision of the estimates of the cyclical positions of the three observed variables produced by the STSM, I follow *Rünstler and Vlekke* (*2018*) and perform the pseudo-real-time estimation of the current cyclical position of the data. To put it in terms of the model presented above, the cyclical components plotted in *Figures 2* and *3* are smoothed estimates based on all of the available data, which we can denote as $\hat{x}^c_{t|T}$, where T is the last quarter when the data are available. The pseudo-real-time estimate $\hat{x}^c_{t|t}$ of the cyclical position for quarter t uses only the data that would have been available at that time – that is, up to quarter t. To evaluate the precision of this "real-time" estimate, we can compare

it with another estimate $\hat{x}^{c}_{t|t+20}$, which incorporates an additional 20 quarters of data after period t – this benchmark can be thought of as a revision of the initial real-time estimate after 5 years.

Figure 4 plots the pseudo-real-time estimates of the GDP, credit and house price cycles, together with their revisions after 5 years. Naturally, the revision is not available for the last 5 years, because this revision requires 5 years of data available after the "real-time" estimate is made. Note that both estimates use the model parameters that are estimated for the entire available data set, so the discrepancy between the two does not account for parameter uncertainty. We can see that the "real-time" estimates are visibly close to their revised values for all three variables.

Figure 4
Pseudo-real-time estimates for Hungary



Note: Pseudo-real-time estimates of the cyclical components of the three observed variables, compared with their revisions after 5 years, based on the estimated structural time-series model (STSM). The last panel shows the univariate estimates based on the Christiano-Fitzgerald filter (CF) with the frequency band set to 32–120 quarters.

Of course, there is a degree of imprecision in the real-time estimates. For example, *Rünstler and Vlekke* (*2018*) report that across the European countries and the US, the sample standard deviations of the cyclical components are about 30 per cent lower on average for the pseudo-real-time estimates than the sample standard deviations for the revised estimates. In other words, the real-time estimates tend to under-estimate the cyclical deviations. This is a well-known feature of statistical methods that decompose time series into trends and cycles: these methods tend to rely heavily on the tails of the time series to measure the trend and are therefore less likely to discover cyclical dynamics at the end of the time series than in the middle of it. The "real-time" estimates for Hungary also show a downward bias, especially for the financial series: they tend to be closer to zero than the revised estimates. However, the multivariate model performs much better than the commonly used univariate filters. To illustrate this point, I construct the pseudo-real-time estimate and the 5-year revision of the house price cycle using the univariate Christiano-Fitzgerald filter with the frequency band set to 32–120 quarters and plot the two series in the last panel of *Figure 4*. It is evident that the univariate filter performs worse: the real-time estimate shows a much more pronounced downward bias, and the revisions are substantial over the entire sample. As the series are too short, and due to space constraints, I refrain from reporting the statistics for the pseudo-real-time estimates. It should be noted that they are in line with *Rünstler and Vlekke* (*2018*) – and with a more general result established by the empirical literature that multivariate estimates of the cycles are more precise than univariate filters (for example, see *Watson 2007*). Nevertheless, even when relying on multivariate estimates, policymakers should be concerned with the downward bias of the real-time estimates of the cyclical positions of the economy and its financial sector, and thus with the possibility of missing the right moment to act.

4.2. Poor quality of the early data

When estimating the STSM model, I have relied on all the available observations for GDP, credit volume and house prices, trying to collect as long a data set as possible. Even with this approach, the earliest available Hungarian figures for the three series jointly is the first quarter of 1990. The fact that the data series available for Hungary are rather short is a concern for the validity of the results of the estimation, as already mentioned. Moreover, an additional weakness of the data set is that the earlier observations are of quite poor quality. With regard to the house price index, its values for the 1990s are computed based only on data from Budapest. As for the credit volumes, their estimates are also questionable for the 1990s, when the credit market was transitioning towards a free market, together with the rest of the economy. As an additional check for the robustness of the results to the shortness of the data and to the poor quality of the initial observations, I repeat the maximum-likelihood estimation of the same STSM model using the data starting 2000q1.

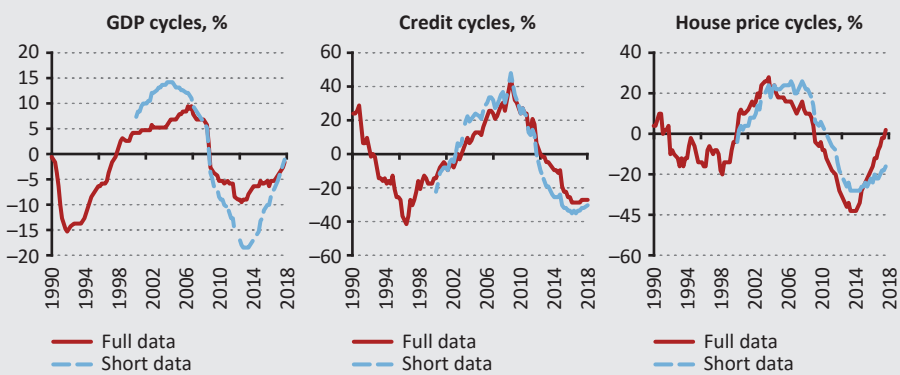
Table 3
Cyclical properties of the observed variables in Hungary, short data

	Variable		
	Y_t	C_t	P_t
Cycle length, years	18.753	17.635	18.094
Cycle volatility, per cent	11.077	25.234	18.535

Note: Cyclical properties of the observed variables: GDP (Y_t), credit (C_t) and house price (P_t). The table shows estimates of the average length and the standard deviation of the cyclical components of the model obtained using the data between 2000q1–2018q1.

Table 3 contains the key results of the estimation. There are sizable quantitative differences between the results of this experiment and the estimation over the full data set reported in *Table 1*. Qualitatively, however, the results are the same: house price and credit exhibit cycles longer than 15 years on average; the financial series are 2–2.5 times as volatile as GDP; the GDP cycles are longer than what is believed to be the business-cycle range of 2–8 years. *Figure 5* plots the cyclical positions of the three observed series based on the shorter data series and compares them with the estimates based on the full data set presented in *Figure 2*. With the exception of the volatility of the GDP cycles, we can see that both estimates are very similar. This result is reassuring. Despite the fact that the Hungarian data is rather short, we can see that the STSM produces robust estimates, and the characteristics of the Hungarian financial cycles can be approximately measured even using a shorter data set.

Figure 5
Estimates of cyclical components – short and long data



Note: Estimates of the cyclical components of the three observed variables produced using the data between 2000q1–2018q1 and compared with estimates produced using the full data set between 1990q1–2018q1.

5. Conclusion

Following *Rünstler and Vlekke* (*2018*), I conduct an estimation of a multivariate structural time-series model using the Hungarian data, in order to establish the characteristics of the Hungarian financial cycles, as summarised by the dynamics of the volume of private banking sector credit and house prices. Although the data available for Hungary are short, I manage to produce evidence of persistent financial cycles consistent with the international empirical evidence. Robustness checks indicate that even a short data set that is available for Hungary is sufficient to characterise its financial cycles. The estimation also reveals that the cyclical behaviour of GDP is related to the financial cycles, since there is strong medium-term coherence between output and the financial series. At the same time, it is easy to miss medium-term cyclical output fluctuations and their relation to the financial cycles when using the popular univariate filters. The Hungarian data suggests relatively long and volatile financial cycles – at the same time, Hungary happens to be the country with a very high home ownership rate, which puts the evidence from Hungary in line with the findings for other countries. Also in line with the existing literature, the findings suggest that the multivariate model is capable of producing real-time estimates of the cycles that are more precise than the estimates coming from univariate filters.

In terms of the policy implications, a few points are in order. The established connection between GDP and the financial cycle may serve as an additional argument for coordination between monetary and macroprudential policy. For the purposes of timely and, importantly, accurate decision-making, the findings argue for pooling the data together and relying on multivariate estimates. Finally, substantial differences between the features of the financial cycles in different countries may provide guidance for country-specific macroprudential policies.

References

Aikman, D. – Haldane, A.G. – Nelson, B.D. (2015): *Curbing the credit cycle*. The Economic Journal, 125(585): 1072–1109. https://doi.org/10.1111/ecoj.12113

Banai, Á. – Vágó, N. – Winkler, S. (2017): *The MNB's house price index methodology*. MNB Occasional Paper 127.

Berki, T. – Szendrei, T. (2017): *The cyclical position of housing prices – a VECM approach for Hungary*. MNB Occasional Paper 126.

Drehmann, M. – Borio, C.E.V. – Tsatsaronis, K. (2012): *Characterising the Financial Cycle: Don't Lose Sight of the Medium Term!* BIS Working Paper No. 380.

Galati, G. – Hindrayanto, I. – Koopman, S.J. – Vlekke, M. (2016): *Measuring financial cycles with a model-based filter: Empirical evidence for the United States and the euro area*. DNB Working Paper No. 495. https://doi.org/10.2139/ssrn.2722547

Gonzalez, R.B. – Lima, L. – Marinho, L. (2015): *Business and Financial Cycles: an estimation of cycles' length focusing on Macroprudential Policy*. Banco Central do Brasil Working Paper 385.

Harvey, A.C. – Koopman, S.J. (1997): *Multivariate structural time series models*. In: Heij, C. – Schumacher, J.M. – Hanzon, B. – Praagman, C. (ed.): System Dynamics in Economics and Financial Models. New York: Wiley, pp. 269–285.

Hosszú, Zs. – Körmendi, Gy. – Mérő, B. (2015): *Univariate and multivariate filters to measure the credit gap*. MNB Occasional Paper 118.

Kocsis, L. – Sallay, M. (2018): *Credit-to-GDP gap calculation using multivariate HP filter*. MNB Occasional Paper 136.

Reinhart, C.M. – Rogoff, K.S. (2009): *This time is different: Eight centuries of financial folly*. Princeton University Press.

Rünstler, G. – Vlekke, M. (2018): *Business, housing, and credit cycles*. Journal of Applied Econometrics, 33(2): 212–226. https://doi.org/10.1002/jae.2604

Rünstler, G. – WGEM Team on Real and Financial Cycles (2018): *Real and financial cycles in EU countries - Stylised facts and modelling implications*. ECB Occasional Paper No. 205.

Schularick, M. – Taylor, A.M. (2012): *Credit booms gone bust: Monetary policy, leverage cycles, and financial crises, 1870–2008*. American Economic Review, 102(2): 1029–1061. https://doi.org/10.1257/aer.102.2.1029

Watson, M. (2007): *How accurate are real-time estimates of output trends and gaps?* Federal Reserve Bank of Richmond Economic Quarterly, 93(2): 143–161.

Capital Market Contagion in the Stock Markets of Visegrád Countries Based on the Heckman Selection Model*

Máté Csiki – Gábor Dávid Kiss

In our study, we examine contagions materialising between the stock market indices of three countries in the Visegrád region – Poland, Czech Republic, Hungary – and selected developed countries – USA and Germany. The sample covers the period between 1997 and 2017, which includes a number of events that caused major financial and capital market turbulences in past decades, the effects of which are still significant on the capital markets of the Visegrád region today. We simulated the comovement of Visegrád and developed markets with a DCC procedure, and applied the Heckman selection model – a novel technique in relevant studies – to explain the volatility of the correlation and to capture collective behaviours between the markets. Our analysis of the extreme returns of regional indices reveals increasing global integration across the regional equity markets and their exposure to the oil market. The relevance of our work is confirmed by the presence of contagions – as presented within the framework of the model – between the regional indices and the S&P500 as well as the DAX index which are caused by financial and capital market shocks, while there is also evidence of a significant impact exerted by the German stock market index on the Visegrád stock indices. Periodically and as a function of market shifts, some variance can be observed in the contagion channels, and the unique properties specific to the region can be recognised.

Journal of Economic Literature (JEL) codes: G15, C33, F65

Keywords: contagion, Heckit, equity market

1. Introduction

In recent decades, more and more emphasis has been placed on recognising and addressing shocks related to deepening global financial and capital market

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Máté Csiki is PhD Student at the Faculty of Economics of the University of Szeged.
E-mail: csiki.mate@eco.u-szeged.hu
Gábor Dávid Kiss is habil PhD, Associate Professor at the Faculty of Economics of the University of Szeged.
E-mail: kiss.gabor.david@eco.u-szeged.hu

This research was supported by the project EFOP-3.6.2-16- 2017-00007, entitled *Aspects on the development of intelligent, sustainable and inclusive society: social, technological, innovation networks in employment and digital economy*. The project has been supported by the European Union, co-financed by the European Social Fund and the budget of Hungary.

The Hungarian manuscript was received on 26 February 2018.

DOI: http://doi.org/10.25201/FER.17.4.2352

integration, the spread of financial innovations and global liquidity flows. Along with theories focusing on fundamental-based contagion, arguments emphasising financial and capital market relationships as key contagion channels have increasingly come into focus (*Király et al. 2008*). The external financial adjustment of small, open economies across Europe took place rapidly; the resilience of the economies to external financial shocks improved after the financial crisis of 2008–2009 (*Magas 2018*). Analyses breaking away from fundamentals with a new focus on financial market relationships increasingly came to the foreground in the aftermath of the "devastating crises" of the past two decades, emphasising shocks stemming from abrupt changes in capital flows and the importance of high-leverage finance. Stability may be upset by temporary disturbances arising from global financial imbalances and sudden shifts in liquidity flows. All of this can be traced back to the development of network structures across capital markets and the resulting collective behaviour exhibited in relation to extreme events.

The study examines contagions materialising between the stock market indices of three countries in the Visegrád region[1] (V3: Poland, Czech Republic, Hungary) and selected developed countries (the USA and Germany). In order to avoid the bias stemming from its lower level of liquidity, the Slovakian stock market is not included in the sample. The review covers the period between 1 January 1997 and 8 September 2017. The sources of weekly data are stooq.pl and the "ARAD" database of the Czech National Bank.

First, we used a dynamic conditional correlation (DCC) model to analyse the dynamic conditional comovement of regional and developed stock market indices. Then, with the assistance of the financial market variables applied, we attempted to explain the volatility of the comovement simulated by the DCC model by running the Heckman selection model – a novel technique in relevant studies – with special regard to detecting contagions unfolding around extreme events. The results of the Heckman model point to the presence of contagions arising from shocks between developed and regional markets and the financial market variables applied in the model suggest possible descriptions for the correlation change. In addition to the presence of contagions, it is important to highlight the time profile of the changes in possible causal channels and their diverging effects amid extreme negative and extreme positive returns.

Following a presentation of the empirical antecedents affecting the region, we discuss collective capital market behaviour and provide an overview of the relevant literature, with special regard to the presentation of capital market contagions. After describing the model and methodology applied in the research, we then analyse the comovement between regional and developed markets and give an overview

[1] For the rest of the article we refer to these countries as "V3" on numerous occasions.

of the extremities of the Visegrád stock market indices. The article concludes with a description of the results received after running the Heckman panel regression, first for the entire review period of 1997–2017 and subsequently, after dividing the period into three parts in accordance with the attribute of ascending depression, for the resulting three periods.

2. Theoretical overview

For the interpretation of the results, we need to present the empirical antecedents of covariance analyses affecting the Central and Eastern European region and the manifestations of the consequences of capital market complexity and collective behaviour in money market contagions, divergence and interdependency.

2.1. Empirical background

Gelos – Sahay (*2000*) studied financial market spillovers on the stock prices of the V3 economies. Starting from 1993, financial market integration increased significantly, especially during the period of the 1998 Russian crisis. The authors found that the Hungarian equity market has the largest exposure and the Czech equity market had the smallest exposure to the contagion emanating from the Russian crisis, which is also confirmed by *Schotman – Zalewska* (*2006*) in relation to the 1997 crash in Asia and the 1998 Russian crisis. *Cappiello et al.* (*2006*) referred to an increasing degree of integration from the 2000s in the V3 countries. Correlation of the V3 with the German and American markets increased substantially during the 2007–2008 subprime crisis, which is consistent with the research of *Syllignakis – Kouretas* (*2011*), who estimated a rise in the correlation coefficient from 0.5 to 0.75 during the crisis with the use of a DCC model. The heightened volatility observed during crisis periods is accompanied by a rise in dynamic conditional correlation coefficients, which may serve as evidence for financial market contagions between V3 and developed (German and US) markets. *Baumöhl et al.* (*2011*) found that correlation between the markets ranged between 0.5 and 0.7 on average, with significant outliers around the crisis periods.

Pukthuanthong – Roll (*2009*) measured the integration between the V3 and developed markets by the degree of determination by global factors. They found that stock market prices in Visegrád countries can be significantly explained by global factors from the 1990s, which points to a high level of integration. *Gilmore et al.* (*2012*) found evidence of long-run cointegration between the V3 and German equity markets.

Wang – Moore (*2008*) investigated comovement between the three emerging Central and Eastern European stock markets with the euro area market over a sample period from 1994 to 2006 by utilising a DCC model. The correlation coefficient ranged between 0.3 and 0.5. The authors also observed that the Asian and Russian crises and EU accession strengthened the level of integration. *Savva and Aslanidis* (*2010*)

also relied on a DCC model to measure the degree of correlation between the V3 and the euro area and demonstrated that the Polish and Czech markets increased their correlation to the euro area from 1997 to 2008, whereas for the Hungarian market the correlation, although high, remained constant. The integration between the V3 and the euro area increased over time, especially after EU entry, and remained strong even during the subprime crisis (*Gjika – Horvath 2012*).

In summary, we can conclude that the events of the past few decades strengthened the integration between the V3 and developed markets significantly (*Baumöhl – Lyócsa 2014*). EU accession negotiations and the efforts of V3 countries to bring their regulatory framework and legal standards in line with European Union directives improved investors' confidence. Improvements in stock exchange operations and trading regulations, accession to the EU, intensification of foreign investments and capital inflows and more flexible exchange rate regimes across the region all contributed to the increase in the region's comovement with developed markets. The subprime crisis, crisis management and the European debt crisis raised the Visegrád region's level of integration even further. In addition, the European Union adopted the IFRS standards, which also determine the consolidated reporting obligations of listed companies. According to a Hungarian survey, publicly traded companies also pay special attention to convincing stakeholders because – in addition to the statutorily prescribed content – they provide a considerable amount of voluntary disclosures (*Kovács 2015*), which assists in gaining and retaining the confidence of investors.

2.2. Definition of collective behaviour and its presence in the relevant literature

According to *Bonanno et al.* (*2001*), the complex interpretation of capital markets has three consequences. On the one hand, price returns and volatility are only asymptotically stationary, while the autocorrelation of returns is monotonously decreasing for at least twenty trading days. On the other hand, a high degree of cross correlation may exist between different sets of time series. This leads to the third level of complexity, which points to the existence of a type of collective behaviour in capital markets during extreme market events. In capital markets, collective behaviour manifests itself in contagions, interdependence and divergence.

Based on Kiss (*2017*), three levels can be distinguished in the definition of contagion. With respect to contagion according to the narrowest definition of the term that we used for the purposes of this study, we observed significantly increased correlation in turbulent periods compared to calm periods. In our study, we divided $\mathbb{H}$ capital market returns into two – an $\mathbb{N}$ normal and an $\mathbb{X}$ extreme – sets, where the $\mathbb{H} = \mathbb{N} \cup \mathbb{X}$ correlation holds true. The *n* index included in the definitions denotes normal, whereas the *x* index denotes extreme V3 stock market returns. m_i refers to regional indices, while m_j refers to developed indices.

Definition: Capital market contagion is understood as a significant increase in the ρ^{m_i,m_j} correlation between m_i, and m_j markets under extreme returns in the Visegrád markets (*Kiss 2017*):

$$\rho_n^{m_i,m_j} < \rho_x^{m_i,m_j} \quad (1)$$

Accordingly, if weekly returns in the m_i market are divided according to normal and extreme returns, we will observe a significantly higher correlation between the m_i, and m_j markets under extreme returns ($\rho_x^{m_i,m_j}$).

Király et al. (*2008*) identify financial and capital market relationships as key contagion channels. Studying the 1997 crisis in the Far-East and the 1998 crash in Russia, *Van Royen* (*2002*) asserts that the propagation of contagion does not depend on the macroeconomic fundamentals of the given country. A number of studies pointed out that amidst sharply declining and volatile stock prices, shocks induce a significant increase in the comovement of equity markets (*Campbell et al. 2002*; *Lin et al. 1994*). The 1998 rouble crisis drew attention to high-leverage financing as a possible cause of contagion; the global liquidity shortage gave rise to financing problems, and high-leverage funds withdrew simultaneously from geographical regions which were apparently not related in any way (*Király et al. 2008*). *Wong – Li* (*2010*) observed that a disruption in the balance of global capital flows triggers capital flights on a global scale, while the market comovements generated by the shock considerably hampers the basic function of diversification, i.e. the effectiveness of risk spreading.

In studying contagions, it is important to highlight the phenomenon of herding, especially when fundamentals cannot fully explain the shocks emerging in the financial system and their spillover. Herding behaviour occurs when market participants excessively imitate the behaviour of others, which may contribute to the persistence of asset price bubbles or even fuel further price inflation (*Lakos – Szendrei 2017*). The increasing financial openness and the intensifying liberalisation of capital flows often entail rapid shifts in short-term capital movements (*Magas 2010*). Indeed, globalisation mitigates the need for the gathering of country-specific information; investors define the balance between portfolio diversification and costly additional information gathering themselves (*Magas 2010*). This also puts homogenisation into the foreground. *Syllignakis – Kouretas* (*2011*) provided an empirical verification of the herding behaviour relevant to the region when, in relation to the subprime crisis, they emphasised the herding observed in the Central and Eastern European region.

Using wavelet analysis, *Dewandaru et al.* (*2018*) investigated the evidence of contagion between the stock market indices of Germany, France, the United Kingdom, Sweden and Switzerland in the context of the great crises of the past decades, along with a number of factors of the intensifying financial integration that

exacerbate external vulnerability. The authors found that prior to the US subprime crisis, contagions generated only short-term shocks in the markets under review. They underpinned the role of the French, German and British markets in the spread of the crisis, while calling attention to the extreme strength of the contagion effects in the case of the 2008–2009 crisis and the European sovereign debt crisis, where signs of contagion appeared in all index-pairs.

Over the longer term, within fundamental linkages, market comovements tend to reflect real economic embeddedness (*Chen – Zang 1997*), whereas global factors appear to be the driving force behind short-term fluctuations (*Van Royen 2002*). In the case of strong linkages between two economies, an interdependence can be observed in stable periods, whereas significantly increased correlations around shocks signal the presence of contagion (*Forbes – Rigobon 2002*). The close economic ties of Central and Eastern European countries with Germany strongly determine the magnitude of dynamic conditional correlations. European stock market indices are far more likely to correlate with German indices than with the US indices, while an extreme rise in the US DJI index provides evidence of interdependence between the V3 indices and the DAX index (*Kiss 2017*). *Wang et al.* (*2017*) found evidence of interdependence between the US–Chinese, US–Japanese and US–Russian capital markets in the context of the US subprime crisis. In order to interpret these events, we need to clarify the concept of interdependence, i.e. a manifestation of collective behaviour beyond contagion.

Definition: In the case of capital market interdependence, the ρ^{m_i,m_j} correlation between m_i, and m_j markets does not change significantly under extreme returns in the Visegrád markets (*Kiss 2017*):

$$\rho_n^{m_i,m_j} \approx \rho_x^{m_i,m_j} \tag{2}$$

Accordingly, if weekly returns in the m_i market are divided according to normal and extreme returns, we will not observe a significantly different correlation between the m_i, and m_j markets under extreme returns ($\rho_x^{m_i,m_j}$).

In response to the crisis, there is evidence of significantly decreasing comovement in the case of US, EMU, Polish, Hungarian and Czech 10-year bond yields (*Kiss – Kosztopulosz 2012*). *Farkas* (*2011*) pointed out that the Visegrád countries constitute an unique economic model. Investors view countries with similar properties homogeneously, based on such properties as geographical location, economic structure, history or credit rating. In the case of shocks, investors seek to simultaneously shed from their portfolios all assets that are regarded as homogenous. As a previously homogeneous region collapses as a result of this heterogenisation, this process appears as capital market divergence (*Bearce 2002*).

Definition: When capital market divergence occurs, there is a significant decline in the ρ^{m_i,m_j} correlation between m_i, and m_j markets under extreme returns in the Visegrád markets (*Kiss 2017*):

$$\rho_n^{m_i,m_j} > \rho_x^{m_i,m_j} \tag{3}$$

Accordingly, if weekly returns in the m_i market are divided according to normal and extreme returns, we will observe a significantly lower correlation between the m_i, and m_j markets under extreme returns ($\rho_x^{m_i,m_j}$).

3. Methodology

We used a dynamic conditional correlation (DCC) model to analyse the dynamic conditional comovement of regional and developed stock market indices. We sorted the extreme returns of the V3 indices by a VaR (Value-at-Risk) procedure and then tried to explain the volatility of the comovement under extreme returns by running the two-step Heckman panel regression with the help of the variables applied. For our calculations we utilised Matlab R2014a and the Gretl software package.

3.1. DCC-GARCH (dynamic conditional correlation)

Generalised ARCH, i.e. GARCH (Generalised Autoregressive Conditional Heteroscedasticity) models are key tools in addressing the problems arising from autoregression and heteroscedasticity. In the GARCH(p,q) model p and ε^2 define the lookback period of the error term, while q and σ^2 define the lookback period of the standard deviation; α_i denotes the effect of present news on conditional variance, while β_i denotes the persistence of volatility; i.e. the shock exerted by new information on old information (*Kiss 2017*):

$$\sigma_t^2 = \omega + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^{q} \beta_i \sigma_{t-i}^2 \tag{4}$$

Defining the α_1 and β_1 parameters in the case of GARCH(1,1) models is of crucial importance. The baseline GARCH(1,1) model assumes that present volatility is a function of past volatility and returns and that there is no difference between the market responses to positive and negative information shocks.

In order to provide evidence of collective behaviours on financial and capital markets, we need to verify temporal changes in correlations, for which it is indispensable to observe the time factor and to strip out heteroscedasticity from the changes in comovements. The dynamic conditional correlation (DCC) model is suitable for this exercise.

Based on *Engle* (*2002*), the dynamic conditional correlation model (DCC model) simulates the conditional $\sigma_{i,t}^2$ variance of time series that can be characterised with $r_t \| \phi_{t-1} \sim N(0,H_t)$ return and all ϕ_{t-1} information available at *t–1* point in time:

$$\begin{bmatrix} \sigma_{i,t}^2 & \sigma_{i,j,t} \\ \sigma_{i,j,t} & \sigma_{j,t}^2 \end{bmatrix} = \sum_{i=1}^{p} \alpha_{i,j} \begin{bmatrix} e_{i,t-p}^2 & e_{i,j,t-p} \\ e_{i,j,t-p} & e_{j,t-p}^2 \end{bmatrix} + \sum_{i=1}^{q} \beta_{i,j} \begin{bmatrix} \sigma_{i,t-q}^2 & \sigma_{i,j,t-q} \\ \sigma_{i,j,t-q} & \sigma_{j,t-q}^2 \end{bmatrix} \tag{5}$$

3.2. Extreme price movements

Kiss – Varga (*2016*) observed that extreme events can be removed by means of parametric (statistical) or non-parametric approaches. The statistical approach assumes that the dataset is characterised by some probability distribution (e.g. normal distribution), and removes ($\mathbb{X}$) outliers on this basis. For our purposes, we applied the VaR calculated from the conditional volatility received from the fitting of the GARCH model, a method widely used for risk perception in financial and capital markets. Assuming a normal distribution, extreme returns (r_{XVaR}) under the VaR model comprise logarithmic price fluctuations at a probability level below 5 per cent. In this case, returns are considered extreme where with a probability of 95 per cent they fall farther than within a standard deviation of 1.65 from the expected assumed value of zero (*Madura 2008*). That is,

$$r_{XVaR+} > \mu + 1{,}65 \cdot \sigma_t \quad \text{and} \quad r_{XVaR-} < \mu - 1{,}65 \cdot \sigma_t , \tag{6}$$

assuming that $\mu \cong 0$ and that conditional volatility is σ_t.

3.3. Heckman selection model

We examined the volatility of the comovement between Central and Eastern European and developed stock price indices and the appearance of collective behaviours with the Heckman selection model (*Heckman 1976*). The method removes extreme return values from the time series, and describes the factors that trigger extreme returns of the variables that might cause extremities (7). The model is suitable to observe the collective behaviour that occurs in financial and capital markets. A significantly deviating value of the constant (β_1) received from the regression equation (9) may point to contagion or divergence, while a significantly non-deviating value of the constant may signal interdependence, in consideration of the strength and sign of the coefficients and the value of the explanatory variables. The regression equation of the model (9) is capable of capturing the factors influencing the volatility of the comovement between developed and V3 markets ($X_i^{'}$), as well as their direction and the magnitude of their impact (β_i). The coefficient of the variables shows in which direction and to what extent a given variable influences the dynamic conditional correlation under an extreme negative and extreme positive yield environment of the V3 indices. The model is based on a two-step regression: the first step is the selection mechanism that sorts and explains tail events (Z^* = 1 cases). The second step is a regression model which explains the drivers of the fluctuations in the comovement of V3 and developed market with the assistance of variables incorporated into the model that prevail under tail events.

Selection mechanism (step 1):

$$Z_i^* = w_i^{'}\gamma + u_i ;\ Z_i = 1 \text{ if } Z^* > 0, \text{ otherwise 0; where } Z_i = 1 \text{ denotes extreme returns,} \tag{7}$$

$$\text{Prob}\left(Z_i = 1 \middle| w_i\right) = \phi\left(w_i^{'}\gamma\right) \text{ and } \text{Prob}\left(Z_i = 0 \middle| w_i\right) = 1 - \phi\left(w_i^{'}\gamma\right). \tag{8}$$

Regression model (2nd step):

$$Y_i = X_i'\beta + \varepsilon_i \quad Z_i = 1 \text{ , where } Y_i \text{ is the dynamic conditional correlation.} \qquad (9)$$

The error terms of the selection and regression equations (u_i, ε_i) are independent and follow a bivariate normal distribution; moreover, we measure the ρ correlation between the error terms ($corr[u_i, \varepsilon_i] = \rho$). If the value of the ρ correlation is 0, the β coefficients of the OLS model are free from specification error, i.e. the model can be used. In that case, Heckman's λ parameter will be significant and the results received can be interpreted within the framework of the model (*Greene 2003:784*, Formula *22–20*; *Wooldridge 2012*).

3.4. The model

The selection mechanism of the Heckman selection model applied is constructed as follows, if $Z_{i,t} = 1$:

$$Z_{i,t} = \alpha_1 + \alpha_2 SP500_t + \alpha_3 LIBOR_t + \alpha_4 Oil_t + u_{i,t}, \qquad (10)$$

where $Z_{i,t}$ denotes the extreme returns of the three Visegrád indices, $SP500_t$ is the US S&P500 stock price index, $LIBOR_t$ is the USD-denominated London interbank interest rate (LIBOR), and Oil_t is the logarithmic return of Brent crude oil. The second step of the Heckman selection model is the regression equation, if $Z_{i,t} = 1$:

$$\begin{aligned} DCC_{ij,t} = \beta_1 + \beta_2 R_{i,t} + \beta_3 RP_{EU\,i,t} + \beta_4 RP_{US\,i,t} + \\ + \beta_5 P_{i,t} + \beta_6 I_{i,t} + \beta_7 I_{DAX\,t} + \beta_8 I_{RTS\,t} + \varepsilon_{ij,t} \end{aligned}, \qquad (11)$$

where $DCC_{ij,t}$ is the dynamic conditional correlation of regional markets with developed markets, *i* is the relevant V3 country and *j* is the relevant developed country. $R_{i,t}$ is the logarithmic differential of the 1-month interbank rate (Bubor, Wibor, Pribor) of the Visegrád countries. $RP_{EU\,i,t}$ is the difference between the 1-month interbank interest rates of the Visegrád countries and the euro area, and $RP_{US\,i,t}$ is the difference between the V3 and the USD-denominated 1-month Libor. $P_{i,t}$ is the logarithmic return of the exchange rate of regional currencies against the US dollar, $I_{i,t}$ is the logarithmic return of the regional indices, $I_{DAX\,t}$ is that of the German DAX stock price index, and $I_{RTS\,t}$ is that of the Russian RTS stock price index.

4. Results

This chapter presents the primary statistics of the variables, the comovement of the developed and Visegrád markets, the extreme returns of the V3 indices and the results of the Heckman selection model.

4.1. Primary statistics

The primary statistics of the variables are presented in *Annex 1*. The expected mean – a value around zero – assumed by the baseline model and low standard deviation

hold true for each individual variable. In the case of the indices, we found negative asymmetry differing from zero. Of the V3 indices, the BUX and the PX exhibit more significant negative skewness. The asymmetry of the Russian RTS index deviates the least from the baseline model. The negative asymmetry suggests that negative exchange rate shocks occur at a higher rate on the equity markets. The presence of the depreciation process that mostly characterises the period causing a positive asymmetry is demonstrated by the skewness of the currencies against the US dollar. Regarding interest rates, an analysis of the third moment reveals substantial differences. Other than the Pribor, the asymmetry of interbank rates is negative. A kurtosis higher than three – fat tailedness – increases the relative frequency of extreme fluctuations. Fat tailedness held true for the return of all variables under review. On the whole, we can conclude that extreme returns are far more likely to occur than random movements in the case of the indices, exchange rates and oil prices, which is also confirmed by the hypothesis of normal distribution, rejected on the basis of the Jarque–Bera test. Based on the Ljung–Box test, the lack of autocorrelation does not hold true for a significant part of the returns. For most variables, the p-values of the ARCH-LM tests point to the homoscedastic nature of the returns. The logarithmic differentials of the time series are covariance stationary: in other words, the first and second moments of the time series do not explicitly depend on time. The application of panel regression requires stationary inputs; we employed the Im, Pesaran and Shin test (IPS) to test for panel stationarity. According to the test, the variables used in the model are stationary (*Annex 2*).

The means of the V3 stock price indices' dynamic comovement with the DAX index exceed the corresponding values with the S&P500. The comovement of all three Visegrád indices proved to be stronger with the German index than with the US index. The deviation of the comovements is stronger in the case of the Czech stock price index and weaker in the case of the Hungarian index (*Annex 3*).

4.2. Dynamic conditional correlation of V3 and developed stock price indices

From 1993, the comovement of regional financial markets with developed markets increased significantly, especially during the period of the 1998 Russian crisis (*Gelos – Sahay 2000*). A surge in the comovement of the three markets can be also observed during the dotcom crisis (*Figures 1 and 2*). Representing the euro area with the DAX index, *Figure 2* demonstrates the assertion by *Gjika – Horvath* (*2012*), namely, that the integration between the V3 and the euro area increased significantly after EU accession and remained strong even during the subprime crisis. In the first half of the review period, the Czech PX index exhibited weaker correlation compared to the region, which can be attributed to heterogenisation. Starting from the end of the 1990s, the Czech Republic pursued a convincing monetary policy and successfully applied an inflation targeting system. Positive expectations regarding the country were significantly reinforced by the performance of the real economy and the country's stable currency, which functioned as a local safe haven.

Figure 1
Dynamic conditional correlation of V3 indices with the S&P500 (1997–2017)

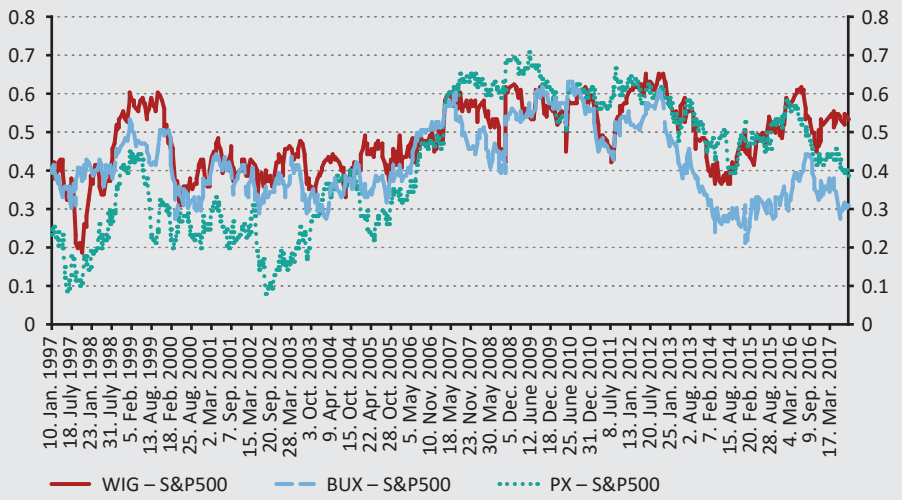
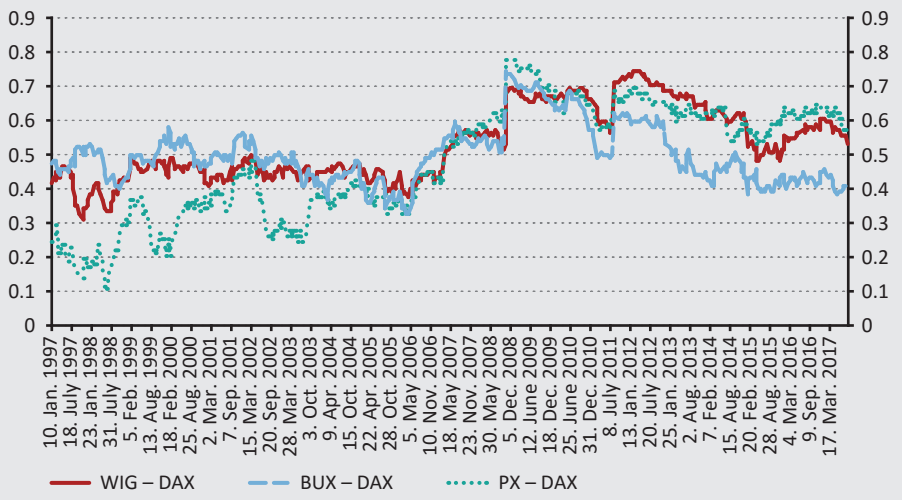


Figure 2
Dynamic conditional correlation of V3 indices with the DAX (1997–2017)



Demand and supply imbalances arising in the market of low-risk assets are among the reasons behind the global liquidity abundance of the first half of the 2000s. The emerging market crises of the 1990s and the dotcom crisis hitting developed markets were identified as the underlying factors of the imbalances, which led to a sharp increase in investors' demand for low-risk assets and the depletion of assets that were deemed to be low risk (*Horváth – Szini 2015*). Owing to the tighter monetary policies adopted in the mid-2000s in response to global excess demand and overheatedness, the V3 countries started to converge significantly to one another, and their correlation with the S&P500 and DAX increased sharply. From 2006 until the outbreak of the crisis, the integration of regional markets and the DAX intensified. The comovement between regional markets and developed markets peaked in the period following the spillover of the crisis to Europe.

After the outbreak of the 2008 financial crisis, the correlations adjusted somewhat, but this process was associated with substantial volatility. The comovement between the markets intensified markedly during the shocks triggered by the European debt crisis, the Greek crisis and the South-European indebtedness. The correlation coefficients rose to the vicinity of the levels measured during the financial crisis, which may serve as evidence of the existence of contagion channels between the financial markets of the European Union. Similarly, comovement between regional markets and developed markets increased in response to the 2015 capital market shocks and uncertainty (turbulence on the Chinese stock exchange, Greek debt management problems).

4.3. Extreme returns of Central and Eastern European indices

It is also apparent in the V3 countries that extreme events are typically more likely to occur in the equity markets during turbulent periods. Regional extremities can be often characterised by the clustering of extreme events around significant crises and periods of capital market turbulence (*Annex 4*). Numerous extreme negative events were observed around the Asian and Russian crises at the end of the 1990s; however, the deepening capital market liberalisation of regional countries gave room for several extreme positive returns as well during the period. The effect of the dotcom crisis in the early 2000s and the global liquidity abundance that lasted until 2005 typically put extreme positive returns in the foreground. At the same time, as the analysis of extreme returns shows, even typically regional shocks (the terror attacks of 2001, the Uruguayan crisis, Venezuelan strikes or Mid-Eastern conflicts) also exerted a significant impact on the regional indices.

Extreme downward price shifts also form a cluster due to the monetary tightening measures of 2005–2006. The uncertain financial and capital market situation preceding the 2008 meltdown and the outbreak of the crisis generated negative returns in the V3 countries as well. Signs of some positive sentiment manifested themselves in capital markets in the second half of 2009, but this was interrupted

from time to time by such events as the escalating European debt crisis, the Greek crisis and the increasing indebtedness of Southern European states. Negative returns also tended to occur more frequently during the periods of uncertainty caused by the faltering of the Chinese economy in 2015 and the persistent Greek crisis. In 2016 and 2017, the predominantly positive sentiment on the global markets prompted positive extreme returns in the Visegrád markets.

For the period as a whole, the procedure identified 92 extreme returns in the case of the BUX and the PX and 103 extreme returns for the WIG (*Annex 5*). The extreme returns had a higher percentage of negative returns. There are more extreme fluctuations in the returns of regional indices in the period preceding the 2008–2009 crisis (1997–2007) than in the post-crisis period (2009–2017). Unusual negative price shocks tended to dominate the crisis period of 2007–2009, while the number of unusual price increases was negligible.

4.4. Heckman selection model

This sub-chapter interprets the results from running the Heckman selection model. The first phase covers the period between 1997 and 2017. In the second phase, we divided the entire time series into three truncated time series: an optimistic period between 1997 and 2007, a crisis period between 2007 and 2009, and a period that lasted from 2009 to 2017.

4.4.1. Heckman selection model – for the entire period

Running the Heckman procedure for the entire period lasting from 3 January 1997 to 1 September 2017 yielded significant lambda values between the stock price indices of the developed countries and the Visegrád indices (*Table 1*). The results obtained can be interpreted in the context of the Heckman model for extreme positive and extreme negative movements in the Visegrád indices alike.

Table 1
Result of the model for the whole period (1997–2017)

	DCC-SP500-V3				DCC-DAX-V3			
Z_i	Extreme positive		Extreme negative		Extreme positive		Extreme negative	
Variable	Coeff.	p value	Coeff.	p value	Coeff.	p value	Coeff.	p value
constant	−1.9184	0.00***	−1.7376	0.00***	−1.9186	0.00***	−1.7373	0.00***
SP500	11.6676	1.13e−09***	−16.6209	8.03e−025***	12.2659	5.56e−011***	−16.5308	1.33e−024***
LIBOR	−0.3223	0.7157	1.8518	0.0497**	−0.5779	0.4869	2.0597	0.0285**
OIL	2.9057	0.0019***	−2.0260	0.0143**	2.2891	0.0122**	−1.9565	0.0181**
$DCC_{i\,j}$	Extreme positive		Extreme negative		Extreme positive		Extreme negative	
Variable	Coeff.	p value	Coeff.	p value	Coeff.	p value	Coeff.	p value
constant	0.6422	0.00***	0.5746	0.00***	0.8079	0.00***	0.6335	0.00***
R_i	0.5189	0.1519	−0.4373	0.0112**	0.2457	0.5216	−0.3339	0.0493**
$RP_{EU\,i}$	−0.2112	0.0796*	0.0688	0.0633*	−0.2497	0.0513*	0.0434	0.2376
$RP_{US\,i}$	−0.0442	0.605	0.0948	0.3171	0.0174	0.8471	0.0298	0.7486
P_i	−1.5087	0.0138**	0.9522	0.0202**	−1.1712	0.0582*	1.2943	0.0014***
I_i	0.193	0.6861	−0.0913	0.7562	−0.2759	0.5815	0.098	0.7367
I_{DAX}	−0.1156	0.8388	0.1384	0.6217	−0.0502	0.9256	0.0769	0.7792
I_{RTS}	−0.2009	0.2966	0.2691	0.0801*	−0.0149	0.9426	0.3029	0.0433**
Lambda	−0.1158	0.0680*	−0.0739	0.0189**	−0.1604	0.0006***	−0.0666	0.0141**

Note: The selection mechanism is constructed as follows: $Z_{i,t} = \alpha_1 + \alpha_2 SP500_t + \alpha_3 LIBOR_t + \alpha_4 Oil_t + u_{i,t}$, *where* $Z_{i,t}$ *denotes the extreme returns of the V3 index,* $SP500_t$ *is the S&P500 index,* $LIBOR_t$ *is the USD-denominated London interbank interest rate (LIBOR) and* Oil_t *is the logarithmic return of Brent crude oil. The regression equation is* $DCC_{i\,j,t} = \beta_1 + \beta_2 R_{i,t} + \beta_3 RP_{EU\,i,t} + \beta_4 RP_{US\,i,t} + \beta_5 P_{i,t} + \beta_6 I_{i,t} + \beta_7 I_{DAX\,t} + \beta_8 I_{RTS\,t} + \varepsilon_{i\,j,t}$, *where* $DCC_{ij,t}$ *is the dynamic conditional correlation of regional markets with developed markets, i is the specific V3 country and j is the specific developed country.* $R_{i,t}$ *is the logarithmic differential of the 1-month interbank rate (Bubor, Wibor, Pribor) of the Visegrád countries.* $RP_{EU\,i,t}$ *is the difference between the 1-month interbank interest rates of the V3 and the euro area, and* $RP_{US\,i,t}$ *is the difference between the V3 and the USD-denominated 1-month Libor.* $P_{i,t}$ *is the logarithmic return of the exchange rate of regional currencies against the US dollar,* $I_{i,t}$ *is the logarithmic return of the regional indices,* $I_{DAX\,t}$ *is that of the German DAX stock price index, and* $I_{RTS\,t}$ *is that of the Russian RTS stock price index. If p<0.1 then *, p<0.05 **, p<0.01 ***.*

Extreme events on Central and Eastern European stock markets

Based on the model, whenever comovements can be observed between the Visegrád indices and both developed markets similar factors affect the extreme positive and extreme negative movements in the regional indices. Of the variables included in the model, a robust shift in the S&P500 index and oil price movements significantly influenced the extreme positive returns of the V3 indices, whereas extreme negative returns were also affected by the Libor, as the proxy variable for global risk.

Amid both positive and negative shocks, changes in the global investment environment – i.e. changes in the S&P500 index – generate the same impact on Central and Eastern European stock price indices. Due to the significant exposure

of the reviewed countries and indices to the oil market, oil price shocks exert a significant impact on the extreme fluctuations of stock price indices. The returns of regional indices move in the same direction in response to changes in global economic activity, which is consistent with the findings of *Aloui et al.* (*2013*). Through the discount factor effect, the intensification of global risks and an increase in discount rates on the corporate side may adversely affect stock prices (*Jammazi et al. 2017*). In the increasing interest environment of shock periods, investors may be nudged to the bond market and may reduce the share of stocks in their portfolios. As the inverse effect of rising interest rates, stock prices decline through the asset price channel (*Baele et al. 2013*).

The substantial effect of the three global variables on the shocks sustained by the regional stock price indices underpin the V3 indices' dependence on global factors as proposed by *Pukthuanthong – Roll* (*2009*). This demonstrates the broad-based global integration of the regional indices stemming from capital market liberalisation. *Van Royen* (*2002*) found that real economic integration is not fully determining in the case of short-term fluctuations. An extreme strengthening or weakening in the S&P500 index triggers a shift in the same direction in regional markets, which may be evidence of financial contagion between the US and V3 stock price indices.

Contagions

Outlying constant values (significantly stronger dynamic conditional correlation) between developed and regional markets may signal contagions emerging in turbulent periods. The comovement constant of regional indices and the US index is 0.64 and it is 0.80 in the case of regional indices and the German index in an extreme positive return environment (*Table 1*). It should be noted, however, that constant values are influenced by the coefficient of the explanatory variables and by the values taken by the variables. In a positive return environment, the coefficients of the variables under review are negative; in other words, they reduce the value of the comovements. In an extreme negative return environment, the constants are 0.57 and 0.63, i.e. their values are lower than in the case of extreme positive returns (*Table 1*). As opposed to the positive return environment, in a negative return environment the positive coefficient of most variables under review strengthens the degree of comovements further, as a function of the values taken by the variables. The average values of the explanatory variables may also differ as a function of market shifts. The higher the constant values with the German market, the closer the comovement of regional indices with the German market than with the US market, which is consistent with the empirical results so far. *Chen and Zang* (*1997*) pointed out that strong economic ties, as is the case between the Visegrád region and Germany, are a main determinant in the region. The study by *Fałdziński et al.* (*2016*) confirmed that the German, Polish, Hungarian and Czech capital markets are characterised by a similar long-term path. Gilmore et al. (2012) found evidence of

long-run cointegration between the V3 and German equity markets. Over the long term, the direction of the money and capital markets of the Visegrád countries may be influenced by the German market.

Comovement under extreme positive returns

In the case of unusual strengthening, of the variables included in the model the Euribor risk premium and the exchange rate against the US dollar explain the changes in the comovement of developed markets and the Central and Eastern European indices (*Table 1*). Changes in the conversion rate vis-a-vis the US dollar have a stronger effect on the correlation between US and regional markets than between the German and the regional markets as opposed to the Euribor risk premium, the amplitude of which is stronger where there is a comovement with the German market.

Interest rates affect stock markets through numerous channels. On the one hand, the key policy rate influences stock prices through the portfolio rebalancing effect. On the other hand, stock prices also affect interest rates; an expected decline in stock prices signal pessimism regarding the future performance of the real economy, to which the monetary authority is expected to react with an interest rate cut (*Jammazi et al. 2017*). Besides inverse effects, effects may also be exerted in the same direction along the lines of the flight-to-quality strategy (*Baele et al. 2013*). Increasing regional risk premia may presage a surge in regional risk, which may precipitate a fall in stock prices. In the case of a jump in risk premia during turbulent periods investors try to shed riskier assets in line with the flight-to-quality strategy. As a result, less risky developed market assets are given priority, which may trigger capital outflows from emerging markets. According to the model, rising risk premia scale back the comovement between the developed and the Visegrád countries.

The relationship between the exchange rate and stock market returns can be approached from two sides. In line with the international trading effect, changes in the exchange rate affect equity prices (*Aggarwal 1981*). According to the theory of the portfolio balance effect, equity prices impact exchange rates (*Bahmani-Oskooee – Sohrabian 1992*). In boom periods the stock market is capable of inducing foreign capital inflows, which boosts demand for the local currency. In the model applied, changes in the exchange rate may exert an inverse effect on the comovement between the markets around positive capital market shocks. Weakening of the local currency against the US dollar reduces the comovement between the markets. In the model, global investment appetite increases under extreme positive returns, which may raise local stock price indices. Through the international trading effect, depreciation of the exchange rate exerts a positive effect on the competitiveness of export-oriented firms and improving export performance may in turn increase profits and hence, company value and stock prices (*Aggarwal 1981*).

Comovement under extreme negative returns

In the case of a sharp fall in regional stock prices, the change in the comovement between developed and V3 indices may be explained by changes in the regional interest environment, the Euribor risk premium, the exchange rate and the Russian RTS index (*Table 1*). However, the Euribor risk premium had no effect on the correlation between the German and the V3 indices.

The improvement in the Visegrád interest environment observed around negative shocks may be a sign of a surge in regional risk. During shock periods, investors try to shed riskier assets, which may induce capital outflows both from emerging and developed equity markets, which in turn may explain the increased correlation between equity markets during volatile periods (*Lin et al. 1994*). According to the model, the comovement between developed and regional markets increases overall, but the rising interest environment reduces this effect somewhat. This effect is stronger between the S&P500 and the regional indices. The Euribor risk premium exerts an inverse and weaker effect on dynamic comovement under negative extreme returns than in the case of extreme positive returns.

According to *Table 1,* changes in the exchange rate have a significant impact on comovements in volatile periods. Global investment appetite decreases while correlation between the markets increases in turbulent periods (*Longin – Solnik 2001*). Over the short term, depreciation generates a decline in the indices as it results in higher inflation expectations and consequently, investors become more sceptical about the future performance of the real economy (*Ajayi – Mougoue 1996*). In line with the international trading effect, changes in the exchange rate affect equity prices (*Aggarwal 1981*), the weak currency improves the competitiveness of export-oriented firms, which offsets expectations about the future performance of the economy. This effect can only take hold if demand for the products of export-oriented firms, i.e. the export markets, did not deteriorate.[2] According to the model, in the case of extreme negative returns correlation[3] between developed and Central and Eastern European markets is increased by a change in the exchange rate in the same direction. A change in the returns also affects the exchange rate: in periods of depression stock price declines lead to depreciation of the local currency. Deteriorating investor confidence may generate capital outflows in turbulent periods, which gives rise to depreciation of the local currency. The two effects may materialise concurrently in the financial and capital markets, and their opposing effects may simultaneously shape the relationship between stock prices and exchange rates (*Tsai 2012*). According to *Dimitrova* (*2005*),

[2] Due to the contraction in Western-European export markets in the wake of the 2008–2009 crisis, there was no sufficient demand for Central and Eastern European products; therefore, regional companies were unable to take full competitive advantage of the weakening local currency.
[3] This effect is stronger between the DAX and the regional indices.

this effect may vary depending on the country and on the review period, which can be attributed to differences in capital mobility and the openness of capital markets and trading.

Examining the investor side, the value of international investments declines amid negative financial market shocks. On the one hand, this is because of the stock price effect and on the other hand, through the exchange rate effect a potential currency devaluation undermines the profitability of the positions accumulated so far. Weakening of the local currency may drive the indices into an adverse feedback loop, strengthening the already increased comovement even further.

In addition, it is important to highlight the significance of the Russian RTS index, which can be attributed to the important trade relations and financial ties between Russia and the Visegrád states. Wide-ranging real economic and financial relationships maintain potential contagion channels between the countries concerned. The effect of the Russian stock price index gains significance in the case of an unusual decline in the V3 stock price indices.[4] According to the model, in extreme negative events the Russian RTS index may significantly influence the comovement between developed and regional indices.

4.4.2. Heckman selection model – in optimistic periods and periods of depression

In this sub-chapter, we analyse the entire review period divided into three phases along the lines of boom and depression periods. Drawing from the study by *Wu and Lee* (*2015*), based on the Visegrád stock price indices and applying flexible rules, we divided the entire time series into a boom period between 1997 and 2007, a period of depression between 2007 and 2009, and an optimistic period lasting from 2009 to 2017. In the case of the three fractional periods, we applied the extreme – normal return sorting (VaR procedure) pertaining to the entire review period.

In the first period – the period between 3 January 1997 and 2 March 2007 – the Visegrád states were characterised by increasing openness and accelerating capital market liberalisation. As the economies became increasingly open, their capital markets gradually integrated into the global capital flow chain in a declining interest environment with decreasing risk premia. They switched to more flexible exchange rate regimes and, thanks to the intensifying capital inflows, the period saw a continuous strengthening of the regional currencies (*Novák 2014*). Besides the "dirty float", the interest policy was given the important role of keeping the exchange rates within the desired bands (*Neményi 2009*). Owing to the shift in the demand function, oil prices rose continuously amid strong volatility during the period (*Uliha 2016*).

[4] It is perceived more strongly in the case of a comovement with the DAX index.

During the global financial crisis that dominated the second period (9 March 2007 – 27 February 2009) the stability problems of regional countries and the contagion channels with developed markets were thrust to the foreground. The crisis prompted a sharp, sudden increase in the comovement between regional markets and developed countries. The spillover of the crisis inflicted serious damages to the stability of the financial systems of the regional countries. The 2008–2009 financial crisis and the warning signs of the impending crisis manifested themselves in the form of an extremely strong series of turbulences in the financial and capital markets of both the epicentre and the periphery. Running the two-step Heckman estimation procedure for the period 2007–2009 did not yield any significant result that could have been interpreted in the context of the model.

The third period lasting from 6 March 2009 to 1 September 2017 covers the period of post-crisis recovery and crisis management followed by the European debt crisis and subsequently, the period of global consolidation. Both the global economy and regional economies were characterised by a declining, near-zero interest environment and decreasing and realigning premia (*Kosztopulosz 2012*; *Neményi 2009*). The exchange rates of regional currencies exhibited gradual and at times drastic weakening. In the period of crisis management, oil prices began to climb gradually in response to specific demand shocks but later on – in the second half of 2014 – these specific shocks and technological innovations led to falling prices (*Uliha 2016*).

Analysing the dynamic conditional correlation of the S&P500 and the V3 stock price indices for the truncated periods, running the Heckman panel regression yielded significant lambda values in the case of the extreme positive returns of the 1997–2007 period and in the case of the 2009–2017 period. Changes in the comovement of the German DAX index with regional indices can only be explained with the Heckman model in the case of the extreme positive returns of the 1997–2007 period.

Result of breaking down the time series into specific periods

Examining the comovement between regional indices and the US index, similar to the entire time series but to a lesser degree, a unidirectional change in the S&P500 and oil prices strongly influenced the extreme rise in regional indices[5] even in the pre-crisis period (*Table 2*). At the same time, in the post-crisis model changes in the US index and oil prices affected the extreme returns of the V3 indices to an extent that surpassed the degree observed in relation to the entire time series (*Table 3*). The strengthening of the influence of the US index indicates that global integration strengthened even further in the aftermath of the crisis. As a result of the US subprime crisis and its repercussions, the level of integration of regional

[5] Between the V3–DAX pair, the change in the S&P500 index explains the regional extreme returns.

markets increased further. With a stronger oil price coefficient, running the model for the period 2009–2017 demonstrates the continuously increasing exposure of the Central and Eastern European region to oil prices.

Once we examine the comovement between the V3 and S&P500 indices in the context of the extreme strengthening episodes of the 1997–2007 period, we find that the value of the correlation constant pertaining to the period (0.60) is lower than the corresponding value for the entire sample (0.64).[6] However, as opposed to the total sample, in the pre-crisis model most variables have positive coefficients in extreme positive return environments.

Table 2
Result of the model for the pre-crisis period (1997–2007)

	DCC–SP500–V3				DCC–DAX–V3			
Z_i	Extreme positive		Extreme negative		Extreme positive		Extreme negative	
Variable	Coeff.	p value	Coeff.	p value	Coeff.	p value	Coeff.	p value
constant	−1.7246	0.00***	−1.6274	0.00***	−1.7162	0.00***	−1.6283	0.00***
SP500	9.012	0.0006***	−14.8280	2.67e−011***	9.3871	0.0001***	−14.8884	1.23e−011***
LIBOR	−0.2734	0.914	1.979	0.3162	−1.1244	0.6321	1.8482	0.3518
OIL	2.8621	0.0026***	−1.1038	0.3406	1.3212	0.1316	−0.9546	0.9107
$DCC_{i\,j}$	Extreme positive		Extreme negative		Extreme positive		Extreme negative	
Variable	Coeff.	p value	Coeff.	p value	Coeff.	p value	Coeff.	p value
constant	0.606	0.00***	0.3887	0.00***	0.7083	0.00***	0.3886	0.00***
R_i	1.1935	0.0003***	−0.2067	0.2958	0.6444	0.0515*	−0.065	0.7147
$RP_{EU\,i}$	−0.1364	0.1435	0.0528	0.0800*	−0.2204	0.0067***	0.1437	0.596
$RP_{US\,i}$	−0.0638	0.2959	0.0036	0.9774	0.0041	0.9379	−0.0948	0.4018
P_i	−0.2030	0.7236	1.819	0.0017***	0.4695	0.3515	0.398	0.4424
I_i	1.0497	0.0158**	−0.5197	0.0557*	0.4346	0.2825	−0.394	0.1028
I_{DAX}	−0.6543	0.1186	−0.2218	0.3982	−0.3666	0.3408	−0.0745	0.7501
I_{RTS}	−0.1581	0.2662	0.1718	0.2069	0.0284	0.8501	0.2528	0.0368**
Lambda	−0.1429	0.0003***	−0.0358	0.4216	−0.1612	2.87e−09***	0.0033	0.9107

Note: For the explanation, see the Note to Table 1.

Apparently, the capital market integration of the region was weaker in the pre-crisis period. By contrast, when we examine the comovement between the V3 and the US markets, we find higher correlation constant values in the post-crisis period than for the entire sample. In the post-crisis model most explanatory variables have negative coefficients.

[6] The same is true for the DAX and V3 indices as well.

As opposed to the total sample, in the pre-crisis period changes in the comovement between the Central and Eastern European indices and the US index were shaped by the interest environment of the V3 and the interdependence of regional indices.[7] The interest environment exerts an opposite effect than in the case of the extreme negative returns of the entire period. An analysis of the comovement between the V3 and the US market in the extreme positive return environment of the Visegrád region reveals that changes in interest rates had a dynamic effect on the comovement between the markets in the pre-crisis model, whereas changes in the exchange rate are among the determinants of the post-crisis model. In times of extreme strengthening, there is evidence of the herding behaviour across the Central and Eastern European region. In the region considered homogeneous by investors, the strengthening of an index or an increase in the comovement of an index with developed markets generates a similar effect even in relation to the rest of the regional indices. Similar to the pre-crisis period, the herding behaviour affecting the region can be also observed after the crisis, but in this case, it is triggered by negative shocks.

Table 3
Result of the model for the post-crisis period (2009–2017)

	DCC–SP500–V3				DCC–DAX–V3			
Z_i	Extreme positive		Extreme negative		Extreme positive		Extreme negative	
Variable	Coeff.	p value	Coeff.	p value	Coeff.	p value	Coeff.	p value
constant	−2.1966	0.00***	−1.8659	0.00***	−2.2128	0.00***	−1.9286	0.00***
SP500	15.6471	0.0006***	−17.3024	3.87e−08***	17.112	7.99e−05***	−20.5061	2.82e−08***
LIBOR	−1.8024	0.4587	−0.399	0.8114	−2.0623	0.4631	2.1651	0.2916
OIL	5.0798	0.0182**	−2.8876	0.0661*	4.5196	0.1713	−2.7352	0.1393
$DCC_{i\,j}$	Extreme positive		Extreme negative		Extreme positive		Extreme negative	
Variable	Coeff.	p value	Coeff.	p value	Coeff.	p value	Coeff.	p value
constant	0.9362	0.00***	0.8647	0.00***	0.8459	0.1145	0.6042	0.00***
R_i	0.7082	0.3321	1.6782	0.1918	0.9074	0.2658	−0.7242	0.6486
$RP_{EU\,i}$	−0.5075	0.5315	−0.1262	0.2923	−0.5256	0.5531	−0.0982	0.4928
$RP_{US\,i}$	−0.1071	0.705	−0.2629	0.6561	−0.0678	0.7904	0.5279	0.5192
P_i	−2.4168	0.0683*	−1.0905	0.0540*	−2.0254	0.1445	0.1746	0.7742
I_i	0.4103	0.6841	−1.5878	0.0041***	1.162	0.4855	−0.2266	0.7307
I_{DAX}	−1.3124	0.135	1.6657	0.0012***	−0.4296	0.0381**	0.6047	0.2728
I_{RTS}	−1.4806	0.0032***	0.277	0.2988	−1.4808	0.0126**	−0.4753	0.0776*
Lambda	−0.1771	0.0044***	−0.1918	7.3e−013 ***	−0.1203	0.4845	−0.01218	0.7497

Note: For the explanation, see the Note to Table 1.

[7] Changes in the comovement between the German DAX and regional indices can be explained by the interest environment and the Euribor risk premium.

In the V3–S&P500 relation, changes in exchange rates assume a prominent role in the post-crisis model. In this period, the respective currencies of all three Visegrád states depreciated significantly against the US dollar. A weak local currency may boost the competitiveness of export-oriented firms. However, even export markets contracted owing to the financial crisis and the protracted recovery in the euro area. Presumably, the fact that the exchange rate reduces comovement between the markets both in the case of a positive and a negative strengthening in regional indices can be attributed to the slow recovery in export competitiveness. The significant explanatory power of the Russian index underpins the important trade relations and financial ties between the Central and Eastern European region and Russia, which remained even after the crisis. Based on the model, there is evidence of the contagion effect generated by the underperforming RTS index, which can be attributed both to the Russian crisis in the 2010s and to the Russian sanctions. In addition, an examination of the comovement between the US and regional indices reveals the strong impact of the DAX stock price index in the extreme negative return environment of the region in the aftermath of the crisis. This confirms that the direction of the financial and capital markets of the Visegrád 3 is strongly influenced by the German market over the long term.

5. Summary

The selection mechanism of the Heckman model highlights the increasing global capital market integration of the Visegrád equity markets. The extreme positive returns of the V3 stock price indices were strongly shaped by global investment appetite (S&P500 return) and global economic activity (oil price) variables. However, in an extreme negative return environment the effect of the global variables was stronger, and global risk (Libor) also became a contributor. Breaking down the time series into separate periods demonstrated that the region was characterised by a lower level of global integration preceding the 2008–2009 crisis, but the impact of global factors on the regional indices increased sharply following the crisis.

Based on the Heckman procedure applied for the purposes of this study, we can conclude that the correlation measured between the V3 and developed stock price indices is higher in the case of regional shocks, which points to the emergence of contagions between developed and regional markets. According to the results pertaining to the entire review period, fluctuations in the US S&P500 have a significant impact on regional markets. However, the direction of the financial and capital markets of the Visegrád countries is strongly influenced by the German market, and strong economic ties and financial integration are important determinants in the region. Before the 2008–2009 subprime crisis there was a lesser degree of comovement between the regional indices and developed indices in turbulent periods, but the correlation proved to be stronger after the crisis.

Periodically and as a function of market shifts, some variance can be observed in the contagion channels, and the unique properties specific to the region can be also recognised. With regard to the period as a whole, according to the model the volatility of the comovement between regional and developed markets may also be shaped by the regional interest rate environment, the Euribor risk premium, the exchange rate versus the US dollar and the Russian RTS index. According to the model applied, the comovement between the V3 and the US market in the extreme positive return environment of the Visegrád region was strongly influenced by changes in the interest rate in the pre-crisis period and by changes in the exchange rate in the post-crisis period. Further research is needed in order to identify the direction and effects of various contagion channels and to recognise the significance of the exchange rate.

We also found evidence of herding behaviour across the Central and Eastern European region, and the effect of homogenisation can be observed both before and after the crisis. In a region that is deemed homogeneous by investors, a shift in one of the indices or a change in its comovement with developed markets may nudge the rest of the regional indices in the same direction. The significance of the Russian RTS index across the entire time series and in the post-crisis model can be attributed to strong trade relations and financial ties between the V3 region and Russia, which may also exacerbate the spillover of shocks.

We should also call attention to the limitations of the Heckman selection model. In the case of a severe, systemic crisis – such as the 2008–2009 global financial crisis – the abovementioned ties cannot be measured by the method applied.

References

Aggarwal, R. (1981): *Exchange Rates and Stock Prices: A Study of US Capital Market under Floating Exchange Rates*. Akron Business and Economic Review, 3(9): 7–12.

Ajayi, R.A. – Mougoue, M. (1996): *On the Dynamic Relation between Stock Prices and Exchange Rates*. Journal of Financial Research, 19(2): 193–207. https://doi.org/10.1111/j.1475-6803.1996.tb00593.x

Aloui, R. – Hammoudeh, S. – Nguyen, D.K. (2013): *A time-varying copula approach to oil and stock market dependence: The case of transition economies*. Energy Economics, 39 (September): 208–221. https://doi.org/10.1016/j.eneco.2013.04.012

Baele, L. – Bekaert, G. – Inghelbrecht, K. – Wei, M. (2013): *Flights to safety*. NBER Working Paper Series, No. 19095: 1–51. https://doi.org/10.3386/w19095

Bahmani-Oskooee, M. – Sohrabian, A. (1992): *Stock Prices and the Effective Exchange Rate of the Dollar.* Applied Economics, 24(4): 459–464. https://doi.org/10.1080/00036849200000020

Baumöhl, E. – Lyócsa, S. – Výrost, T. (2011): *Shift contagion with endogenously detected volatility breaks: The case of CEE stock markets*. Applied Economics Letters, 18(12): 1103–1109. https://doi.org/10.1080/13504851.2010.524610

Baumöhl, E. – Lyócsa, S. (2014): *How smooth is the stock market integration of CEE-3?* William Davidson Institute Working Paper, Number 1079. https://econpapers.repec.org/paper/wdipapers/2014-1079.htm. Downloaded: 14 January 2018.

Bearce, D. (2002): *Monetary Divergence: Domestic Policy Autonomy in the Post-Bretton Woods Era*. University of Michigan Press, Ann Arbor.

Bonanno, G. – Lillo, F. – Mantegna, R. (2001): *Levels of complexity in financial markets*. Physica A: Statistical Mechanics and its Applications, 299(1–2): 16–27. https://doi.org/10.1016/S0378-4371(01)00279-5

Campbell, R. – Koedij, K. – Kofman, P. (2002): *Increased Correlation in Bear Markets*. Financial Analysts Journal, 58(1): 87–94. https://doi.org/10.2469/faj.v58.n1.2512

Cappiello, L. – Gérard, B. – Kadareja, A. – Manganelli, S. (2006): *Financial integration of new EU member states*. Working Paper Series No. 683, ECB. https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp683.pdf?469b659d60f16ee2141bcb85eb0aa565. Downloaded: 20 January 2018.

Chen, N. – Zhang, F. (1997): *Correlations, trades and stock returns of the Pacific-Basin Markets*. Pacific-Basin Finance Journal, 5(5): 559–577. https://doi.org/10.1016/S0927-538X(97)00022-X

Dewandaru, G. – Masih, R. – Masih, M. (2018): *Unraveling the Financial Contagion in European Stock Markets During Financial Crises: Multi-Timescale Analysis*. Emerging Markets Finance & Trade, 54(4): 859–880. https://doi.org/10.1080/1540496X.2016.1266614

Dimitrova, D. (2005): *The Relationship between Exchange Rates and Stock Prices: Studied in a Multivariate Model*. Issues in Political Economy, 14: 1–25.

Engle, R.F. (2002): *Dynamic Conditional Correlation - A Simple Class of Multivariate GARCH Models*. Journal of Business and Economic Statistics, 20(3): 377–389.

Fałdziński, M. – Balcerzak, A. – Meluzín, T. – Pietrzak, M. – Zinecker, M. (2016): *Cointegration of Interdependencies Among Capital Markets of Chosen Visegrad Countries and Germany*. Mathematical Methods in Economics, Conference.

Farkas, B. (2011): *A piacgazdaság intézményrendszere az Európai Unió új tagállamaiban* (*Institutional system of the market economy in new European Union Member States*). Statisztikai Szemle, 89(1): 50–76.

Forbes, J.K. – Rigobon, R. (2002): *No contagion, only interdependence: measuring stock market comovements*. Journal of Finance, 57(6): 2223–2261. https://doi.org/10.1111/0022-1082.00494

Gelos, G. – Sahay, R. (2000): *Financial market spillovers in transition economies*. Economics of Transition, 9: 53–86. https://doi.org/10.1111/1468-0351.00067

Gilmore, C.G. – Lucey, B.M. – McManus, G.M. (2012): *The Dynamics of Central European equity market comovements*. The Quarterly Review of Economics and Finance, 48(3): 605–622.

Gjika, D. – Horvath, R. (2012): *Stock Market Comovements in Central Europe: Evidence from Asymmetric DCC Model*. William Davidson Institute Working Papers, Series no. 1035, William Davidson Institute. University of Michigan.

Greene, W.H. (2003): *Econometric Analysis*. Prentice Hall. Pearson. New Jersey.

Heckman, J.J. (1976): *The Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables and a Simple Estimator for Such Models*. Annals of Economic and Social Measurement, 5(4):475–492.

Horváth, D. – Szini, R. (2015): *The safety trap – the financial market and macroeconomic consequences of the scarcity of safe assets*. Financial and Economic Review, 14(1): 111–138. http://english.hitelintezetiszemle.hu/letoltes/5-horvath-szini-en.pdf

Jammazi, R. – Ferrer, R. – Jareno, F. – Hammoudeh, S. (2017): *Main driving factors of the interest rate-stock market Granger causality*. International Review of Financial Analysis, 52 (July): 260–280. https://doi.org/10.1016/j.irfa.2017.07.008

Király, J. – Nagy, M. – Szabó, E.V. (2008): *Egy különleges eseménysorozat elemzése - a másodrendű jelzáloghitel-piaci válság és (hazai) következményei* (*Analysis of a special sequence of events – the crisis on the secondary mortgage market and its consequences* (*also for Hungary*)). Közgazdasági Szemle, 55 (July–August): 573–621.

Kiss, G.D. – Kosztopulosz, A. (2012): *The impact of the crisis on the monetary autonomy of Central and Eastern European countries*. Pénzügyi Szemle, 57(1): 27–51.

Kiss, G.D. – Varga, J.Z. (2016): *Tőkepiaci idősorok extrém elmozdulásai* (*Extreme fluctuations in capital market time series*). Statisztikai Szemle, 94(2): 162–182.

Kiss, G.D. (2017): *Volatilitás, extrém elmozdulások és tőkepiaci fertőzések* (*Volatility, extreme fluctuations and capital market contagion*). JATEPress, Szeged.

Kosztopulosz, A. (2012): *A pénzügyi válság és következményei: monetáris politikai és szabályozási kihívások* (*The financial crisis and its consequences: Monetary policy and regulatory challenges*). In: Farkas, B. (ed.): Válság: mérföldkő az európai integrációban? (Crisis: A milestone in European integration)? University of Szeged, Faculty of Economics, Szeged.

Kovács, Zs. (2015): *Immaterial Assets in the Hungarian Accounting System and Financial Statements*. Pénzügyi Szemle, 2015(2): 231–242.

Lakos, G. – Szendrei, T. (2017): *Explanations of Asset Price Bubbles*. Financial and Economic Review, 16(4): 122–150. http://doi.org/10.25201/FER.16.4.122150

Lin, W.L. – Engle, R.F. – Ito, T. (1994): *Do bulls and bears move across borders? International transmission stock returns and volatility*. Review of Financial Studies, 7(3): 507–538. https://doi.org/10.1093/rfs/7.3.507

Longin, F.M. – Solnik, B. (2001): *Extreme correlation in international equity markets*. Journal of Finance, 56(2): 649–676. https://doi.org/10.1111/0022-1082.00340

Madura, J. (2008): *International Financial Management*. Mason: Thomson.

Magas, I. (2010): *Világgazdasági folyamatok és pénzügyi liberalizáció 1970–2010* (*Global economic processes and financial liberalisation 1970–2010*). MTA PhD Thesis. http://real-d.mtak.hu/521/1/tezisek.pdf. Downloaded: 1 March 2018.

Magas, I. (2018): *Financial Adjustment in Small, Open Economies in Light of the "Impossible Trinity" Trilemma*. Financial and Economic Review, 17(1): 5–33. http://doi.org/10.25201/FER.17.1.533

Neményi, J. (2009): *A monetáris politika szerepe Magyarországon a pénzügyi válság kezelésében* (*The role of monetary policy in Hungary's handling of the financial crisis*). Közgazdasági Szemle, 56 (May): 393–421.

Novák, Zs. (2014): *Monetáris politika, infláció és gazdasági növekedés Kelet-Közép- és Délkelet-Európában* (*Monetary policy, inflation and economic growth in Central and South Eastern Europe*). Közgazdasági Szemle, 61 (July–August): 923–942.

Pukthuanthong, K. – Roll, R. (2009): *Global market integration: An alternative measure and its application*. Journal of Financial Economics, 94(2): 214–232. https://doi.org/10.1016/j.jfineco.2008.12.004

Savva, Ch.S. – Aslanidis, N. (2010): *Stock market integration between new EU member states and the Euro-zone*. Empirical Economics, 39(2): 337–351. https://doi.org/10.1007/s00181-009-0306-6

Schotman, P.C. – Zalewska, A. (2006): *Non-synchronous trading and testing for market integration in Central European emerging markets*. Journal of Empirical Finance, 13(4–5): 462–494. https://doi.org/10.1016/j.jempfin.2006.04.002

Syllignakis, M.N. – Kouretas G.P. (2011): *Dynamic correlation analysis of financial contagion: Evidence from the Central and Eastern European markets*. International Review of Economics and Finance, 20(4): 717–732. https://doi.org/10.1016/j.iref.2011.01.006

Tsai, I. (2012): *The relationship between stock price index and exchange rate in Asian markets: A quantile regression approach*. Journal of International Financial Markets, Institutions and Money, 22(3): 609–621. https://doi.org/10.1016/j.intfin.2012.04.005

Uliha, G. (2016): *Oil and commodity markets' relationship with the macroeconomy.* PhD Thesis, Corvinus University of Budapest. Online: http://phd.lib.uni-corvinus.hu/939/1/Uliha Gabor.pdf. Downloaded: 11 December 2017.

Van Royen, A-S. (2002): *Financial Contagion and International Portfolio Flows*. Financial Analysts Journal, 58(1): 35–49. https://doi.org/10.2469/faj.v58.n1.2508

Wang, P. – Moore, T. (2008): *Stock market integration for the transition economies: Time-varying conditional correlation approach*. The Manchester School, 76(s1): 116–133. https://doi.org/10.1111/j.1467-9957.2008.01083.x

Wang, G-J. – Xie, C. – Lin, M. – Stanley, E. (2017): *Stock market contagion during the global financial crisis: A multiscale approach.* Finance Research Letters, 22 (August): 163–168. https://doi.org/10.1016/j.frl.2016.12.025

Wooldridge, J.M. (2012): *Introductory Econometrics: A Modern Approach*. Cengage Learning, Mason.

Wong, D.K.T. – Li, K-W. (2010): *Comparing the Performance of Relative Stock Return Differential and Real Exchange Rate in Two Financial Crises*. Applied Financial Economics, 20(1–2): 137–150. https://doi.org/10.1080/09603100903266468

Wu, S.J. – Lee, W.M. (2015): *Intertemporal risk–return relationships in bull and bear markets*. International Review of Economics & Finance, 38 (July): 308–325. https://doi.org/10.1016/j.iref.2015.03.008

Annexes

Annex 1: Primary statistics of the variables

Variable	Mean	Standard deviation	Asymm.	Kurt.	Norm. distribution (JB)	Autocorr. (LB)	Heterosc. (ARCH-LM)	Stat. (ADF)
I_{BUX}	0.00	0.04	–1.10	12.54	0	0.00	0.12	0
I_{WIG}	0.00	0.03	–0.57	6.61	0	0.01	0.16	0
I_{PX}	0.00	0.03	–1.07	14.00	0	0.00	0.22	0
S&P500	0.00	0.02	–0.76	9.39	0	0.00	0.09	0
I_{DAX}	0.00	0.03	–0.62	7.46	0	0.17	0.46	0
I_{RTS}	0.00	0.06	–0.32	7.86	0	0.00	0.11	0
P_{HUF}	0.00	0.02	0.43	5.55	0	0.72	0.85	0
P_{PLN}	0.00	0.02	0.77	7.40	0	0.09	0.38	0
P_{CZK}	0.00	0.02	0.25	4.06	0	0.54	0.64	0
OIL	0.00	0.05	–0.60	6.09	0	0.66	0.77	0
R_{HU}	0.00	0.04	–3.65	82.88	0	0	0.17	0
R_{PL}	0.00	0.02	–1.52	24.78	0	0	0.03	0
R_{CZ}	0.00	0.06	9.62	254.44	0	0	0.22	0
R_{US}	0.00	0.05	–6.77	108.47	0	0	0.05	0
R_{EU}	0.00	0.11	–1.55	104.82	0	0	0.20	0
$RP_{EU,HU}$	0.00	0.06	–5.45	197.63	0	0.65	0.97	0
$RP_{US,HU}$	0.00	0.07	3.17	96.29	0	0.00	0.50	0
$RP_{EU,PL}$	0.00	0.05	1.12	34.98	0	0.00	0.00	0
$RP_{US,PL}$	0.00	0.14	3.29	182.11	0	0.00	0.67	0
$RP_{EU,CZ}$	0.00	0.29	–0.42	55.39	0	0.00	0.42	0
$RP_{US,CZ}$	0.00	0.27	1.25	61.02	0	0.11	0.81	0

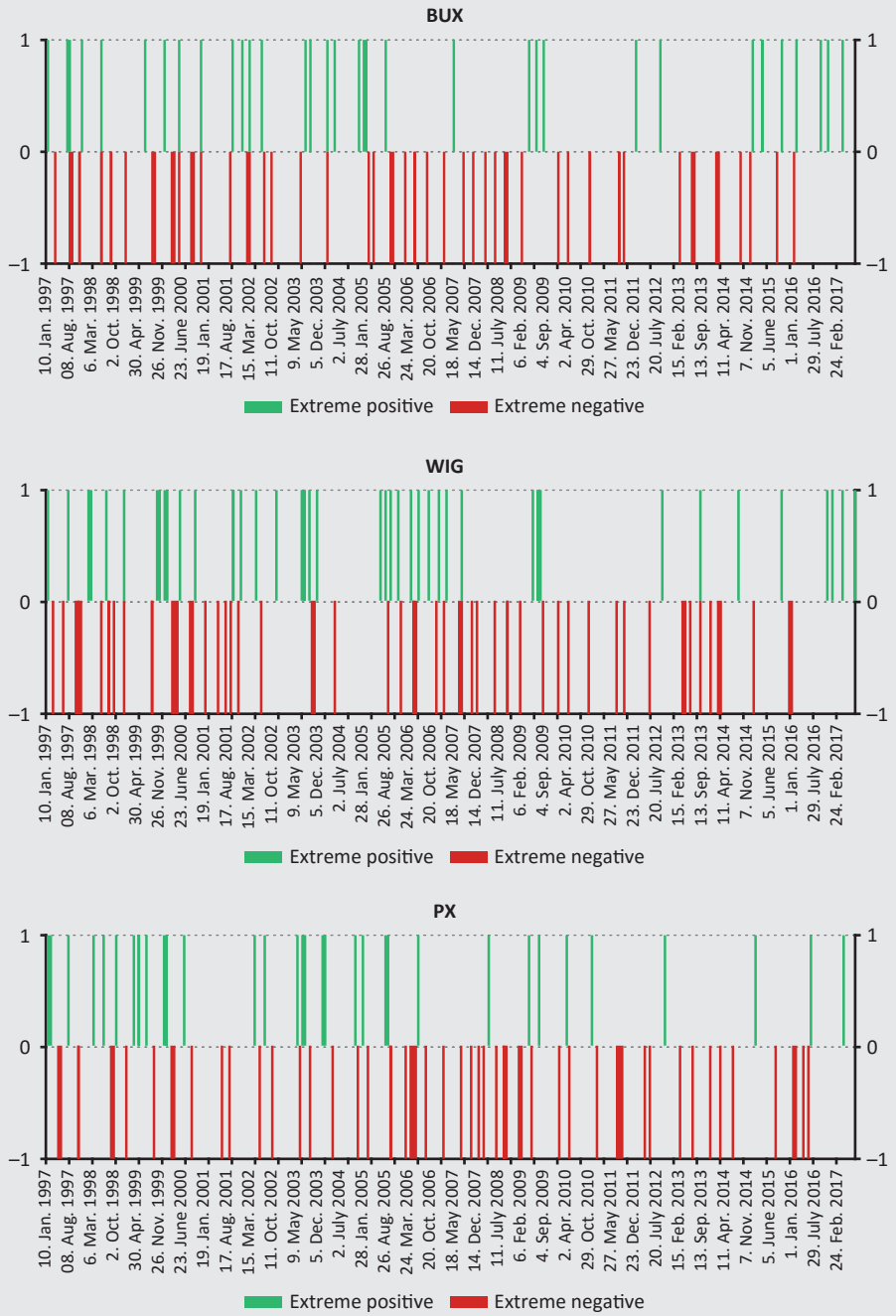
Annex 2: Im, Pesaran and Shin test

W statistics	–114.67
p value of W	0
Z statistics	–117.84
p value of Z	0
Z DF statistics	–146.4
p value of Z DF	0

Annex 3: First three moments of the dependent variables

Variable	Mean	Standard deviation	Asymmetry
$DCC_{BUX,SP500}$	0.42	0.09	0.34
$DCC_{WIG,SP500}$	0.48	0.09	–0.31
$DCC_{PX,SP500}$	0.42	0.17	–0.17
$DCC_{BUX,DAX}$	0.50	0.08	0.75
$DCC_{WIG,DAX}$	0.53	0.11	0.34
$DCC_{PX,DAX}$	0.48	0.17	–0.22

Annex 4: Extreme returns of V3 indices (1997-2017)



Note: Results of the VaR procedure; the horizontal axis denotes trading weeks, on the vertical axis a value of 0 means normal returns, a value of 1 means extreme positive returns and a value of –1 means extreme negative returns.

Annex 5: Occurrences of extreme and normal returns of V3 stock market indices

1997–2017	BUX	WIG	PX	2007–2009	BUX	WIG	PX
total return	1,079	1,079	1,079	total return	105	105	105
"normal" return	987	976	987	"normal" return	97	95	94
extreme return	92	103	92	extreme return	8	10	11
extreme positive	35	44	35	extreme positive	1	2	1
extreme negative	57	59	57	extreme negative	7	8	10
1997–2007	**BUX**	**WIG**	**PX**	**2009–2017**	**BUX**	**WIG**	**PX**
total return	530	530	530	total return	444	444	444
"normal" return	475	466	476	"normal" return	415	415	417
extreme return	55	64	54	extreme return	29	29	27
extreme positive	21	30	26	extreme positive	13	12	8
extreme negative	34	34	28	extreme negative	16	17	19

An Analysis of the Payment Habits of Hungarian Micro, Small and Medium-sized Enterprises – In Focus: Cash Usage*

Ágnes Illés Belházy – Tamás Végső – Anikó Bódi-Schubert

In this study, we examine the cash usage of Hungarian micro, small and medium-sized enterprises along with the main reasons behind the use of cash by analysing data from a questionnaire-based survey conducted on a sample comprising 1,000 corporate managers. In this context, we study the payment habits of enterprises, their ties with financial institutions, the degree of distrust in the Hungarian corporate sector and potential tools for the reduction of cash usage. Wherever possible, we compare our results to the conclusions of previously published Hungarian or foreign research conducted with a similar focus. According to our most important findings, credit transfer is clearly the most prominent payment method both in the SME sector and among microenterprises, but the rate of cash usage is also high and it does not exhibit a declining trend. Positive changes can be observed, however, in payment discipline and business confidence. Hungarian enterprises are loyal to their account manager banks, and although they are essentially open to electronic payment solutions they are highly sensitive to the associated costs.

Journal of Economic Literature (JEL) codes: G30, G32, L14

Keywords: SME sector, microenterprises, cash usage, payment habits, business confidence, credit institution preferences, electronic payment solutions

1. Introduction

Based on the data of the *HCSO* (*2017*), in 2016 a total of 687,698 micro, small and medium-sized enterprises were operating in Hungary. In terms of quantity, this sector accounts for 99.1 per cent of Hungarian businesses and provides employment to more than two thirds of the employees in the corporate sector. In addition, it contributes to the total performance of Hungarian enterprises with 43 per cent of value added and 42 per cent of net sales. It is clear, therefore, that the enterprises

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Ágnes Illés Belházy is Senior Cash Policy Expert at the Magyar Nemzeti Bank. E-mail: belhazynea@mnb.hu
Tamás Végső is Junior Cash Policy Expert at the Magyar Nemzeti Bank. E-mail: vegsot@mnb.hu
Anikó Bódi-Schubert is Head of Department at the Magyar Nemzeti Bank. E-mail: schuberta@mnb.hu

The Hungarian manuscript was received on 26 February 2018.

DOI: http://doi.org/10.25201/FER.17.4.5394

in the SME sector play a prominent role in the Hungarian economy and thus, in payment transactions. Their payment practices and attitude towards cash usage may influence the habits of society as a whole, especially since the overwhelming majority of these businesses operates in the services sector. Excessive cash usage by enterprises undermines the transparency of the sector and impedes control over their activity. Consequently, exploring the underlying reasons of the phenomenon, obtaining an in-depth understanding of corporations' payment habits and analysing their motives for a more widespread use of electronic payment solutions may be of particular importance from an economic perspective.

The main purpose of our study is to measure the role of cash payments in the business transactions of Hungarian micro, small and medium-sized enterprises and examine their primary motives for the use of cash. We also attempt to gain a deeper understanding of the business environment in which payments are generated in the business-to-business (B2B) transactions of enterprises, including payment methods and terms, payment discipline and financial management awareness. We consider the latter aspect particularly important in the sector under review because overdue account receivables or potential bad debts may give rise to serious liquidity problems in corporate operations which, in severe cases, may even limit the enterprise's growth potential or jeopardise its operability. Partly in connection with the previous point, we also assess the financial institution habits of the enterprises concerned as well as their requirements and preferences regarding their account manager credit institution.

In our research, we partly repeated a survey conducted in 2013 with a similar focus, which was aimed at assessing the role of cash in the execution of transactions among the enterprises of the Hungarian SME sector. The results of the survey were summarised in the study by *Bódi-Schubert* (*2014*). As that survey was conducted during the recovery period directly following the economic crisis, the author specifically addressed the issue of trust between enterprises and sought to explore whether the degree of trust could influence the choice between payment methods in practice. Given that the economic environment has significantly improved over the past five years, for the purposes of the 2017 survey we did not place special emphasis on this particular dimension.

The previous, 2013 survey focused on the cash payment habits of small and medium-sized enterprises only. However, since the number of these enterprises is only a fraction of that of microenterprises (according to the data presented in HCSO 2017, in 2016 649,733 microenterprises operated in Hungary while small and medium-sized enterprises comprised only 37,965 firms) and since microenterprises have a particular propensity to use cash owing to their cost sensitivity and low-value transactions, we also involved this sector in our current study. In our survey we did not focus on the sector of large corporations in view of the fact that, based on data

from annual reports, they are less likely to pay in cash; in addition, the client and supplier assessment practices and liquidity management of large corporations can be almost always considered professional.

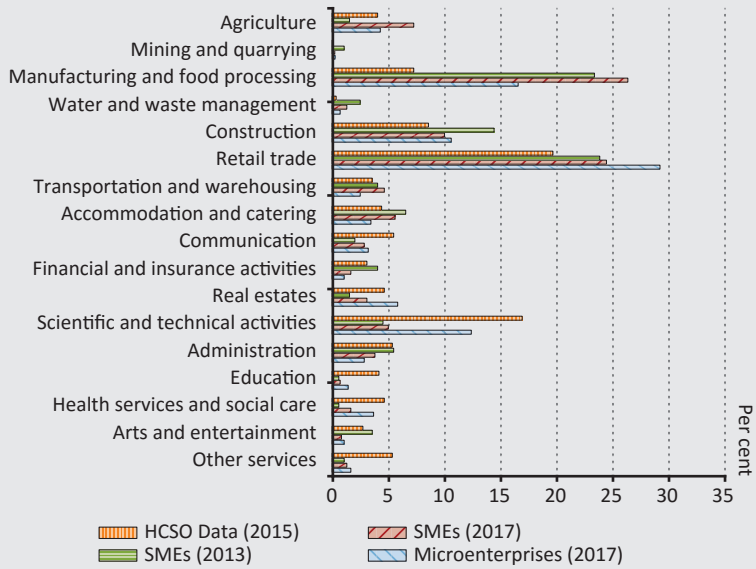
2. Research methodology

Similar to the 2013 survey, in the survey conducted in 2017 we relied on quantitative and qualitative tools to examine the correlations between payment habits and cash usage in the customer and supplier positions among Hungarian small and medium-sized enterprises (including, in particular, microenterprises). *Commissioned by the Magyar Nemzeti Bank* (*MNB*)*, the survey was conducted by the Századvég School of Politics Foundation.*

In the qualitative phase, personal interviews were conducted with 10 enterprises (6 SMEs and 4 microenterprises). In the quantitative phase, the effective sample size was 500 for microenterprises and for the SME sector alike, with each sample comprising Hungarian firms of heterogeneous activities. The survey was taken solely via phone interviews; the questions asked are presented in the *Annex. Figure 1* presents the composition of the quantitative samples – which contain the enterprises participating in the 2017 and 2013 surveys – by activity; the deviation from the actual proportions of Hungarian enterprises based on HCSO data was corrected in the databases by way of weighting. Within the individual activity sectors, the sample is not considered to be representative; moreover, the number of respondents belonging to the same groups on this basis is fairly low; consequently, the suitability of the quantitative results to analyse correlations between the core activity and the payment and cash usage habits of the enterprises is limited.

In the case of microenterprises, the respondents representing the interviewed enterprises were owners/managing directors in every case, whereas the respondents of small and medium-sized companies were owners in 26.8 per cent, managing directors/managers in 46.7 per cent and CFOs/finance managers in 26.6 per cent of the cases. For both enterprise types the questionnaires began with screening questions and questions about the general characteristics of the enterprise concerned (number of employees, net annual sales), followed by questions designed to explore supplier and customer relationships, payment habits regarding the payment of wages and utility bills and the motivations behind the use of cash. The final set of questions of the questionnaires addressed the impact of the administrative measures on payment transactions, the incentives encouraging the reduction of cash usage and aspects of the enterprises' credit institution relations (bank selection, bank switching).

Figure 1
Composition of the samples containing the enterprises participating in the survey by core activity vs. real composition based on HCSO data (%)



Note: Source of HCSO data: Number of active corporations by industries. https://www.ksh.hu/docs/hun/xstadat/xstadat_eves/i_qpg008.html. Downloaded: 12 January 2018

The qualitative survey involved ten semi-structured, theme-oriented interviews conducted in April 2017. The respondents were decision-makers at Hungarian small and medium-sized enterprises in all cases. The selection method ensured that the respondents were able to share their experiences in managing Hungarian enterprises with different activities and geographical locations. The structure of the interviews partly followed the structure of quantitative questionnaires. The clarification of the enterprise's activity and the subject's role in it was followed by a general overview of the supplier and customer relationships. Next, the interview focused on the details of payment transactions and cash usage and on topics related to the relevant experiences of the respondents. The qualitative round of the survey was performed with a view to testing and fine-tuning the questionnaire and in order to gain an initial view on the features of payment practices among the enterprises concerned. Summarising the results and conclusions of the interviews we found that the responses of the interviewees confirmed the results of the quantitative survey in almost every topic. Therefore, in presenting the results of the survey our analysis is restricted to the data of the questionnaire-based survey.

3. Survey results

In this chapter, we present the results of the 2017 quantitative survey in detail and compare them, wherever methodologically possible, to the results of the 2013 survey. Further comparative analysis is hampered by the fact that articles on cash usage and payment habits are typically limited to the examination of households (for example, *Ilyés – Varga 2015, Esselink – Hernández 2017*), while the literature on the SME sector addresses, for the most part, credit conditions and the growth potential of enterprises (for example, *Banai et al. 2016*, *Bethlendi – Végh 2014*). In an international context, the only similar survey available to us was the one commissioned by the British tax authority[1] and conducted by Ipsos MORI Social Research Institute (*Tu – Salmon 2016*), the relevant results of which are presented in *Sub-chapter 3.1.* Our study focuses on enterprises with less than 20 employees, which includes microenterprises – based on the Hungarian interpretation of the concept – and a part of small enterprises. Moreover, in *Sub-chapter 3.4* on payment discipline we also refer to data presented in the study entitled *European Payment Report 2017* published by the international credit management company Intrum Justitia.

3.1. Payment habits, applied payment methods, cash usage

The findings of the 2017 survey indicate that credit transfer is by far the most widespread payment instrument among the ones (cash payments, credit transfer, card payments, other) *examined in the supplier and customer relationships* of Hungarian SMEs and microenterprises. This is followed by cash payments. Compared to these two payment methods, card payments are far less frequent, while other payment methods have all but disappeared from the supplier and customer relationships of SMEs and microenterprises (*Figures 2 and 3*). It should be noted that the question aimed at the applied payment methods offered non-exclusive response options as an enterprise may use multiple payment methods, although the frequency of using the respective methods can obviously be different.

[1] Her Majesty's Revenue and Customs

Figure 2
Percentage of users of specific payment methods in supplier relationships

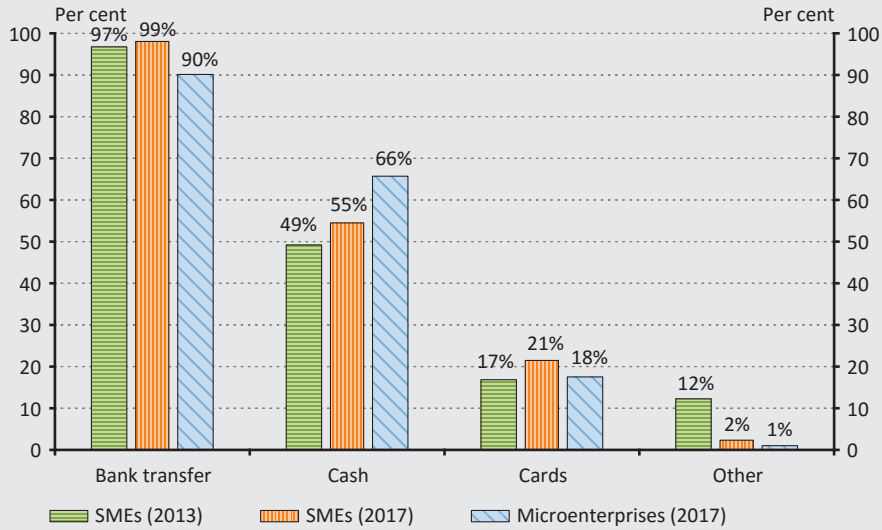
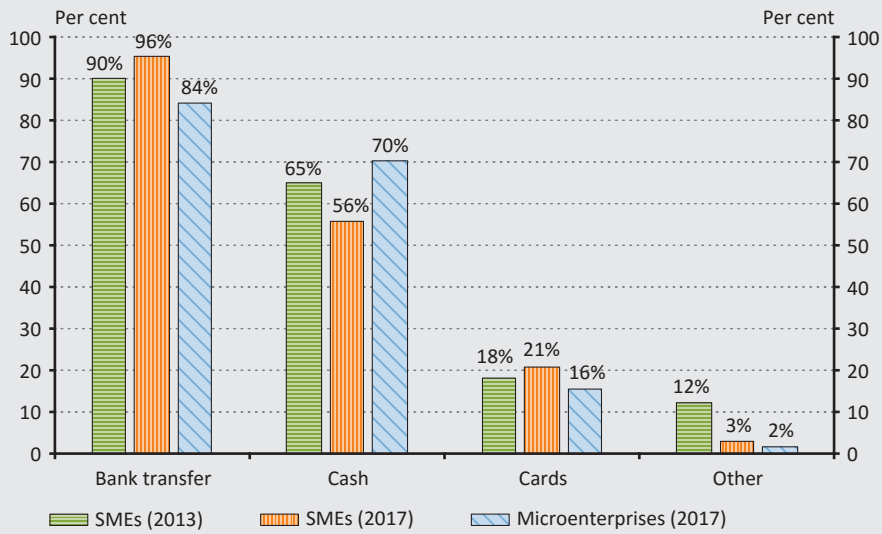


Figure 3
Percentage of users of specific payment methods in customer relationships



As regards credit transfers, we found that their prominence has increased further since 2013 and this payment method has become practically universal: nearly all enterprises initiate and receive credit transfers. *90 per cent of microenterprises rely on this payment method to fulfil their payment obligations, and 84 per cent of them also receive such payments.*

Looking at cash payments, both on the purchase and on the sales sides *users of cash payments are in the majority at SMEs and microenterprises alike* compared to cashless enterprises. *In the supplier relationships of SMEs, the percentage of cash users even increased somewhat compared to 2013* (to 55 per cent from 49 per cent), *whereas in their customer relationships the rate of cash usage declined* (to 56 per cent from 65 per cent). These changes are all the more remarkable considering – as we will see later in the study – that customers' preference is among the most important motives of cash usage; in other words, a large number of enterprises justified their use of cash by the fact that some of their revenues are generated in cash. *The percentage of cash-user enterprises is nearly the same on the customer and on the supplier sides* (as a result of the reverse changes it currently stands at 56 and 55 per cent, respectively), which, however, suggests that the businesses whose cash revenues are generated on the customer side are more likely to use the cash to pay their suppliers than for making a cash deposit to their bank accounts.

The percentage of enterprises using business card[2] *payments is still extremely low,* although it has edged up slightly since 2013 (although this growth is marginal, with a 95 per cent confidence level it can be considered significant). The percentage of card users is only 21 per cent among SMEs with no perceivable growth compared to 2013, while microenterprises use this payment method at an even smaller rate (18 per cent). These rates are similarly low on the customer side: card payments are accepted only by 21 per cent of Hungarian SMEs and only by 16 per cent of microenterprises. Our data fall short of the 30 per cent acceptance rate presented in the *Payment Systems Report* published by the *MNB* (*2018*), mainly because the MNB's value is based on the 2016 OCR database,[3] which predominantly includes retail stores and, to a lesser degree, restaurants and accommodations. The composition of acceptor enterprises by sector was not examined in the context of this survey, but we can deduce even from the core data that *the percentage of acceptor enterprises* – both in the case of SMEs and microenterprises – *falls short of the combined percentage of enterprises which, based on their activity, belong to the sectors that are most likely to accept cards* (trade, vehicle repair, catering, accommodation).[4] This suggests that with regard to card acceptance, there is room for expansion even in these sectors.

[2] In the survey we did not distinguish between the use of credit cards and debit cards; we only focused on the use of business cards as a payment method.
[3] Online cash register database
[4] The composition of participating enterprises by sector is presented in *Chapter 2.*

Based on the survey results, *a large-scale decline can be observed in other payment methods* and, at the same time, there was a pronounced change in the set of other payment methods identified by the respondents. While in 2013 a number of respondents still reported using letters of credit and collection orders as payment methods, in 2017 respondents typically identified vouchers, cash on delivery and "postal cheques" as other payment methods applied by the enterprise.[5]

Comparing our results to the abovementioned survey conducted in the United Kingdom (*Tu – Salmon 2016*), we found that Hungarian enterprises lag behind their British peers mainly in the area of card usage: in the UK 42 per cent of the businesses under review allowed their customers to pay by bankcard (compared to 16 per cent observed in the case of Hungarian microenterprises), while only 67 per cent permitted credit transfers (whereas this rate in the case of Hungarian microenterprises is 84 per cent).

The prominence of specific payment methods can be not only examined in terms of the percentage of the enterprises applying them: we can also focus our attention on the *rate at which the enterprises using the specific payment method rely on that method in fulfilling their payment obligations. The predominance of credit transfers can be clearly established from this perspective as well.* As we have seen, nearly all SMEs (99 per cent) use credit transfers in their supplier relationships, but the survey results also demonstrated that the vast majority of the enterprises using credit transfers (83 per cent) fulfils 76–100 per cent of their payment obligations using this payment instrument. From the perspective of customer relationships, we found that 96 per cent of SMEs use credit transfers for the receipt of incoming payments, and at least three quarters of incoming transactions are actually executed in this way at 76 per cent of the enterprises that use credit transfers. The survey indicates that the most widely used payment method among microenterprises is credit transfer: it is used by 90 per cent of the respondents, and 56 per cent of the users make at least three quarters of their payments in this way.

Although the majority of enterprises use cash both in their supplier and customer relationships, *cash transactions affect only a smaller fraction of their payment transactions.* Most cash-user SMEs (73 per cent) fulfil no more than 25 per cent of their payment obligations via cash payment, and even on the customer side, the enterprises that use cash payment in one quarter of their transactions at most are in the majority (62 per cent). The percentage of SMEs that predominantly use (in at least three quarters of their transactions) cash only was only 4 per cent on the supplier and 11 per cent on the customer side (*Figures 4 and 5*).

[5] The payment instrument referred to by respondents as "postal cheque" – whether they meant postal inpayment money orders or money orders – can be practically regarded cash payments, as is the case with cash on delivery as well.

Figure 4
Cash payments in the supplier relationships of SMEs

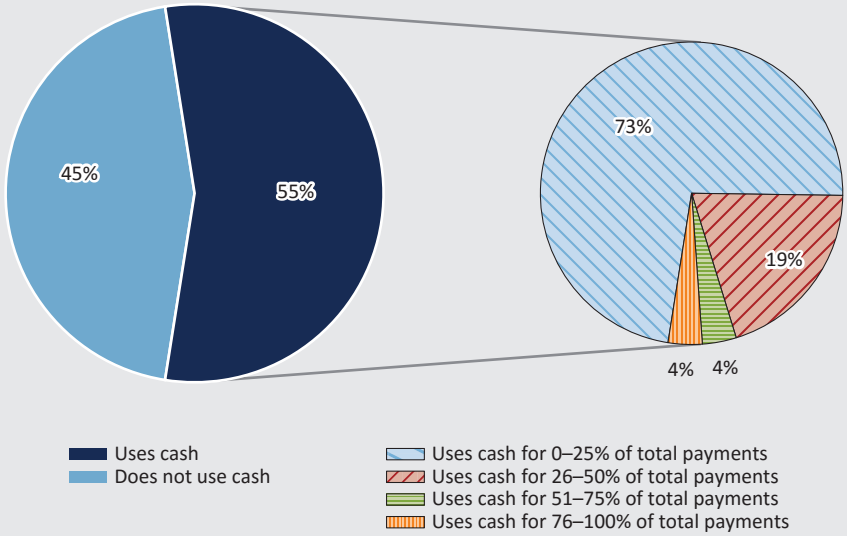
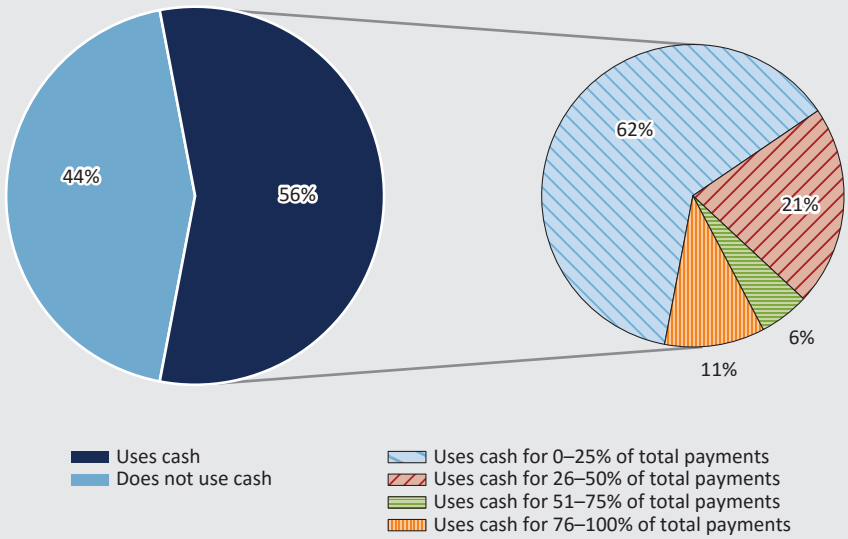
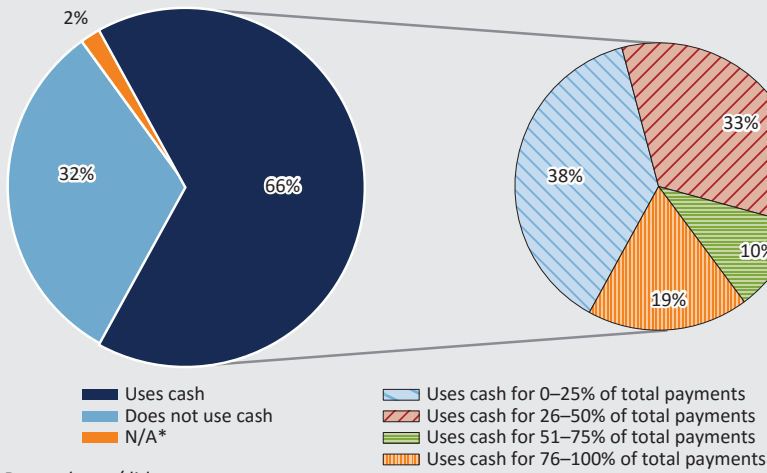


Figure 5
Cash payments in the customer relationships of SMEs



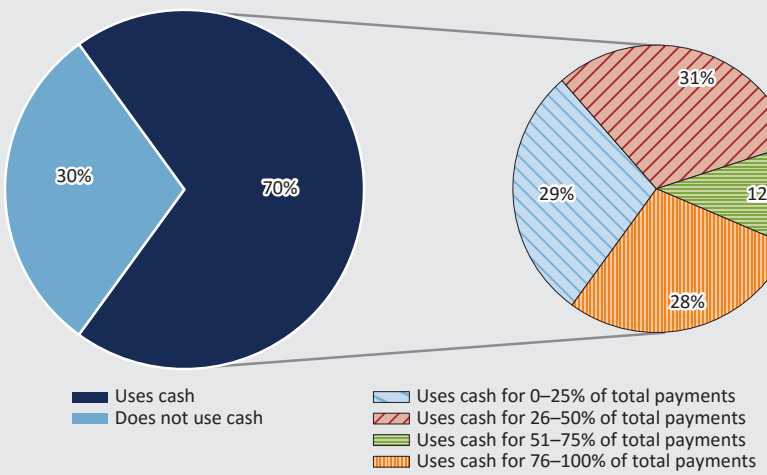
Cash payment is more widespread among microenterprises than among SMEs not only in terms of the percentage of cash users (66 per cent on the supplier side and 70 per cent on the customer side), but also in respect of those reporting a preference for cash transactions. *Nearly one fifth of microenterprises fulfil at least three quarters of their payment obligations in cash, and 28 per cent of them also receive at least three quarters of their incoming payments in cash* (*Figures 6 and 7*).

Figure 6
Cash payments in the supplier relationships of microenterprises



*Note: * Do not know/did not answer.*

Figure 7
Cash payments in the customer relationships of microenterprises



Compared to their British peers, Hungarian microenterprises typically do not rely on cash to a large degree in their customer relationships. While only 9.4 per cent of them handle all of their transactions in cash, in the UK 13 per cent of them refrain from using electronic payment methods altogether, typically in view of the significant costs involved. We can draw mixed conclusions regarding supplier relationships. 7 per cent of Hungarian microenterprises use exclusively cash in this dimension (compared to 19 per cent in the United Kingdom); at the same time, 54 per cent of British enterprises pay their suppliers via electronic means only, while this rate is only 32 per cent in Hungary.

Among SMEs, of the three payment methods under review respondents are the least likely to use bankcards (21 per cent only) and even they tend to resort to this method rather infrequently. The overwhelming majority (89 per cent) use bankcards for only 25 per cent of their payment transactions at most, and a significant portion (73 per cent) of the acceptors reported using card payment in no more than one quarter of the transactions. As is the case with SMEs, at microenterprises card payments play an ancillary role only.

Based on the results presented so far, we can conclude that *cash usage still has a strong presence in the business relationships of the enterprises* – more so in the case of microenterprises than at SMEs – and *its rate has not changed significantly since 2013.* While the frequency of cash payments can be considered secondary in comparison to credit transfers, *its role is not negligible.* Although credit transfers continued to increase their dominance in the past four years, *there was no shift to cashless operation at SMEs* and the presence of cash is particularly strong in the payments of microenterprises.

Since the focus of our study was essentially the cash usage of the enterprises, we specifically *examined the average transaction value of cash payments* both in the supplier relationships (outgoing payments) and in the customer relationships (incoming payments) (*Figures 8 and 9*). As illustrated by the figures, in both payment flows low-value (below HUF 50,000) transactions remained in the majority. Interestingly, however, compared to 2013 we observed a shift in the value of cash transactions towards larger amounts: there was a significant increase in both directions in the HUF 100,000–500,000 category and in payments made to suppliers in the category of HUF 500,000 and above. Based on the in-depth interviews constituting a part of our research, the reason for the phenomenon, presumably, is the financial transaction levy introduced in 2013, which is typically passed on to customers by the financial institutions. In addition, our observations also support our previously mentioned assumption, namely, that Hungarian firms are more likely to use the incomes generated in cash for paying their suppliers (even in the case of higher-value purchases) than for making a cash deposit to their payment accounts.

Figure 8
Distribution of the average value of cash transactions in supplier relationships (%)

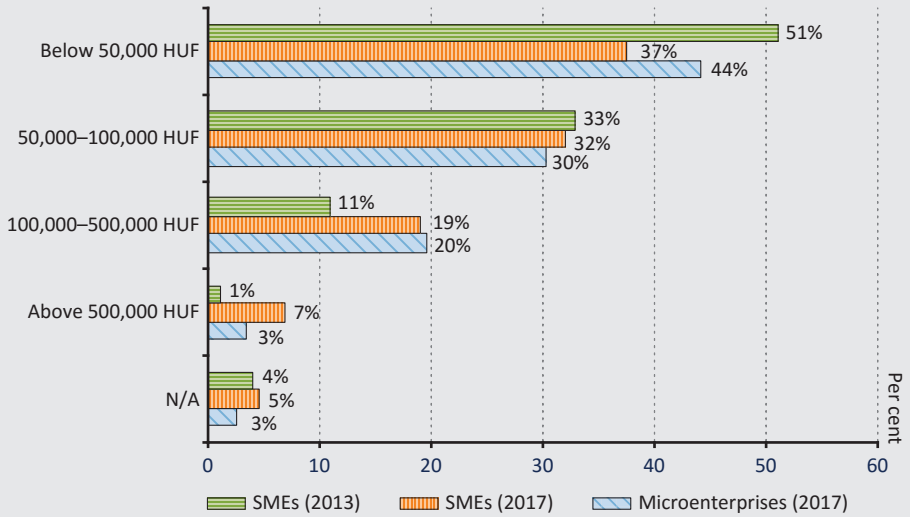
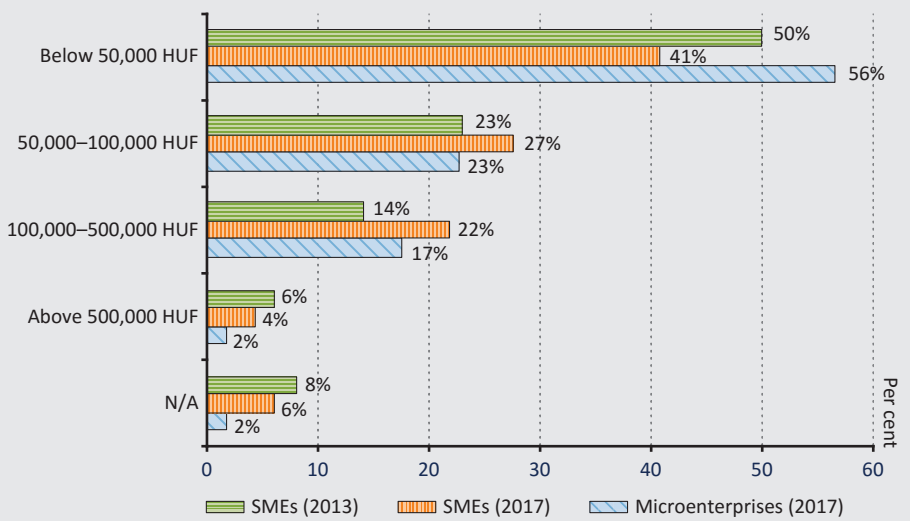
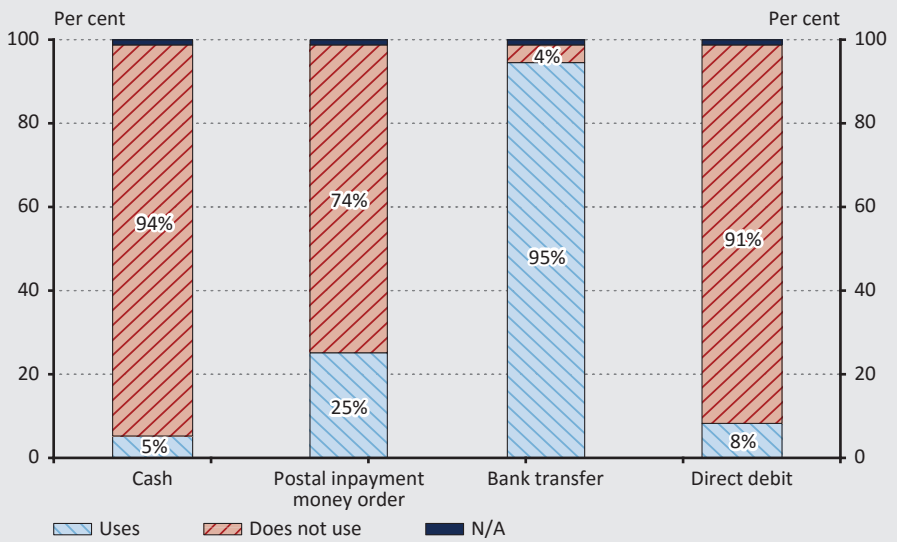


Figure 9
Distribution of the average value of cash transactions in customer relationships (%)



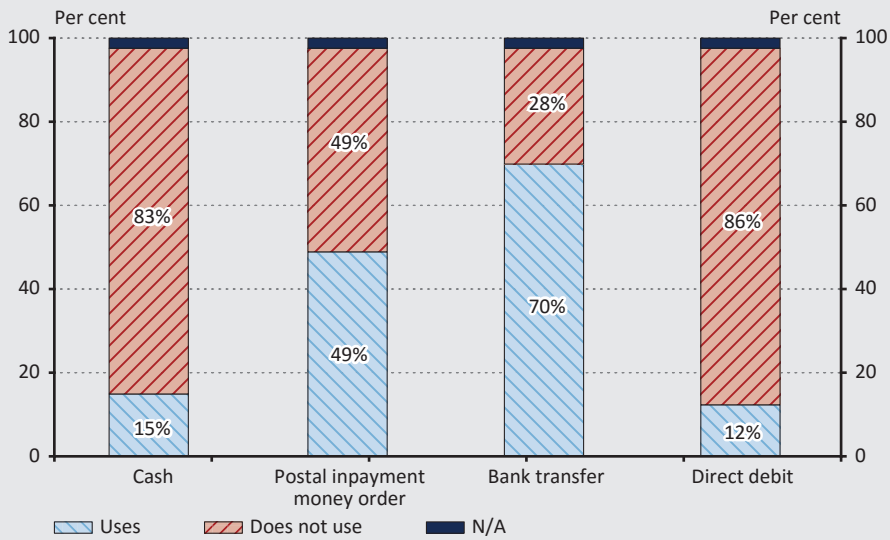
In addition to the payment methods applied in supplier and customer relationships, in the 2017 survey we also asked enterprises to identify the payment methods they typically use for paying their *utility bills* (*Figures 10 and 11*). Respondents were asked to reveal whether they used any of the payment methods listed in the questionnaire (cash, postal inpayment money order,[6] credit transfer, direct debit). Since enterprises can pay individual utility bills in various ways, a respondent could obviously indicate multiple payment methods. On the charts, "cash" indicates the percentage of enterprises making direct cash payments at the customer service offices of the public utility company, while "postal inpayment money order" shows the percentage of enterprises making payments (for example, in post offices) with "yellow cheques".

Figure 10
Percentage of SMEs using specific payment methods for the payment of utility bills (%)



[6] The so-called "yellow cheque"

Figure 11
Percentage of microenterprises using specific payment methods for the payment of utility bills (%)



Most respondents reported using credit transfer for the payment of utility bills as well, but cash payments[7] *are also popular.* Postal inpayment money orders are applied by one quarter of SMEs and by one half of microenterprises, but 5 per cent of SMEs and 15 per cent of microenterprises also use direct cash payments. In this context, our most striking finding concerns the use of direct debit, which is designed specifically for the fulfilment of such payment obligations as utility bills, but an extremely low number of enterprises use this payment option (8 per cent of SMEs and 12 per cent of microenterprises).

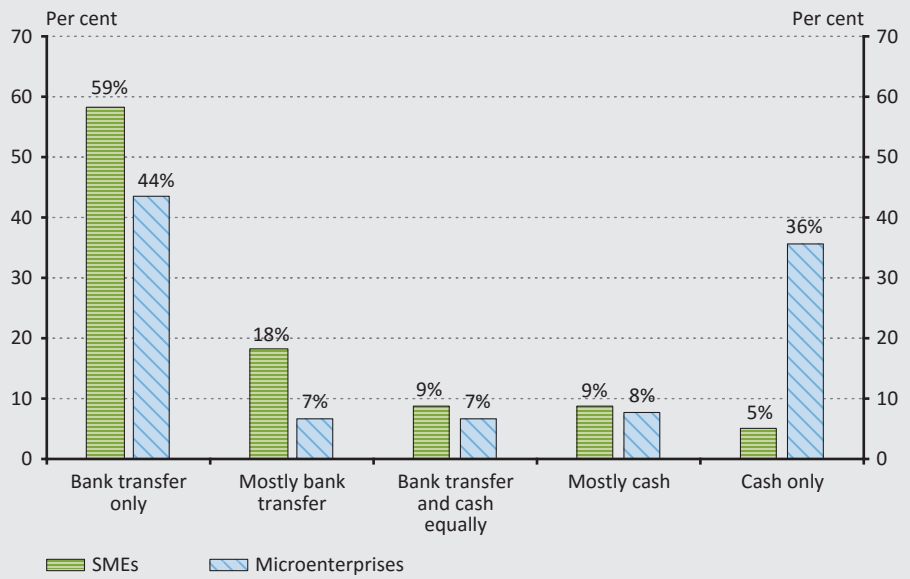
Besides suppliers and utility bills, *wages* imply a regular payment obligation for enterprises. Therefore, our survey was also intended to gauge the rates at which wages are paid in cash and credit transfer (*Figure 12*). The question only covered compensation regularly paid in monetary forms; any other benefits (such as meal vouchers) were excluded from the survey.

Based on the replies, we classified the enterprises into 5 groups depending on the rate at which they paid salaries in cash.[8] *The most typical form of wage payment was credit transfer both among SMEs and microenterprises: nearly 60 per cent of SMEs*

[7] Although nowadays postal inpayment money orders can be paid by card, in view of the enterprises' low propensity to use cards in supplier relationships we typically consider them to be a form of cash payment.
[8] 0%: "Exclusively via credit transfer"; 1–49%: "Mainly via credit transfer"; 50%: "At the same rate"; 51–99%: "Mainly in cash"; and 100%: "Exclusively in cash".

and more than 40 per cent of microenterprises reported paying their employees exclusively via credit transfer. However, while the number of respondents belonging to the groups that have an increasing percentage of cash-based wage payments is continuously decreasing among SMEs and the *percentage of those not using credit transfer for this purpose at all is only 5 per cent, a significant portion – 36 per cent – of the participating microenterprises reported paying their employees fully in cash.* It should be also stressed that according to our survey, around 50 per cent of the microenterprises pay at least half of their employees' wages in cash, the same percentage is far smaller – 23 per cent – among SMEs. Consequently, we may adjust our initial assumption – especially in the case of microenterprises – to the effect that enterprises use the cash inflows from their customers mainly for fulfilling payment obligations towards their suppliers but also, to a non-negligible degree, for paying their employees. Cash payments to employees clearly represent a factor generating cash transactions, as employees drawing their income in cash will obviously settle their household expenses in cash.

Figure 12
Distribution of wage payment via credit transfer vs. wage payment in cash among SMEs and microenterprises (%)



We can conclude that Hungarian microenterprises tend to use cash to pay wages at a fairly high rate by international standards; indeed, according to the British data referred to above, 64 per cent of the enterprises fully settle their wage costs via credit transfer in the UK, whereas the percentage of those using cash exclusively was only 23 per cent.

3.2. Impact of regulatory measures on the payment habits of enterprises

The 2013 survey also asked whether the adoption of certain administrative, regulatory measures affecting payment transactions had an impact on the cash transactions of participating SMEs and if yes, in what direction. That survey found that none of the measures under review (intraday transactions, the cap on B2B cash payments and the financial transaction levy) caused significant changes in the payment practice of the enterprises, and the responses given with regard to the aggregate effect of the measures also indicated that the measures had no substantial effect on the SMEs cash transaction totals neither in terms of outflows or inflows. These findings were also confirmed by the research of *Ilyés et al.* (*2014*) on the features of corporate and household payment transactions. However, since the 2013 survey was taken shortly after the introduction of the measures and the regulation on the financial transaction levy had even changed in the meantime, in our 2017 research we once again asked SME respondents about the potential effects of the two measures (intraday transactions and financial transaction levy) on payments.

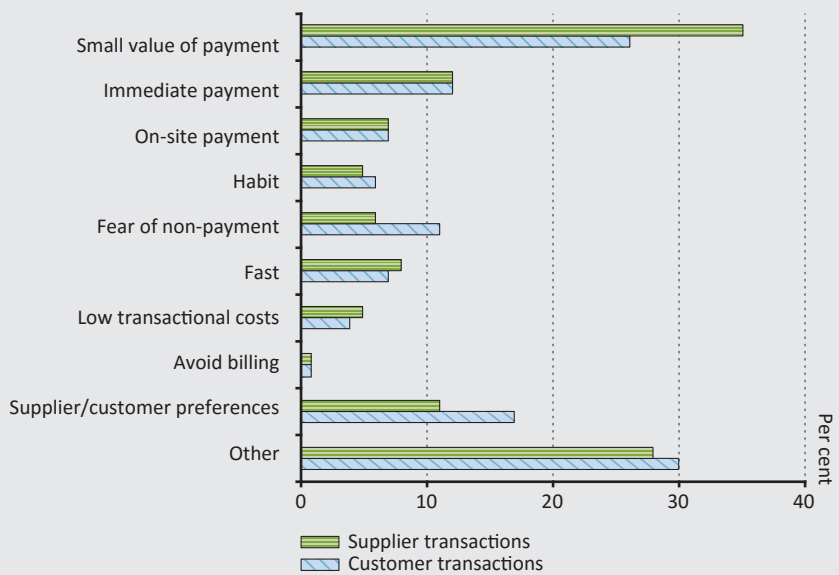
The findings of the 2017 survey regarding the *effect of intraday transactions on cash usage* were mixed: on the one hand, compared to 2013 the percentage of enterprises reporting a perceivable effect of the availability of intraday transactions on their own operation declined significantly (from 87 per cent to 56 per cent); on the other hand, however, the rate of those being able to replace some of their cash transactions by electronic credit transfers thanks to the availability of intraday transactions increased overall (they accounted for only 11 per cent of the respondents perceiving the effect of intraday transactions in 2013 compared to 48 per cent in 2017 which, projected to the whole sample translated into 10 per cent of the enterprises in 2013 and covers 27 per cent of them in 2017). These results suggest that a large number of the enterprises now perceive intraday transactions as a natural part of credit transfers; consequently, they no longer regard them as a special benefit. At the same time, it is clear that *enhancements in the area of electronic payments have a direct impact on the retrenchment of cash usage among enterprises,* which is reconfirmed by the responses given to our questions about the incentives for the reduction of cash usage (see *Sub-chapter 3.6*).

As regards the *financial transaction levy,* in the current survey the enterprises were somewhat more likely to report that the financial transaction levy had no effect on the payment practice of their enterprise (73 per cent in 2017 vs. 68 per cent in 2013). The majority (70 per cent) of those perceiving a change in the enterprise's payment practice, commonly apply the procedure of consolidating individual electronic payment transactions to their partners in order to reach the upper limit of the levy. Only a smaller percentage (15 and 16 per cent) of the enterprises reported an increase in outgoing and incoming cash payments, which covers only 4 per cent of the enterprises included in the total sample.

3.3. Motivations of cash usage

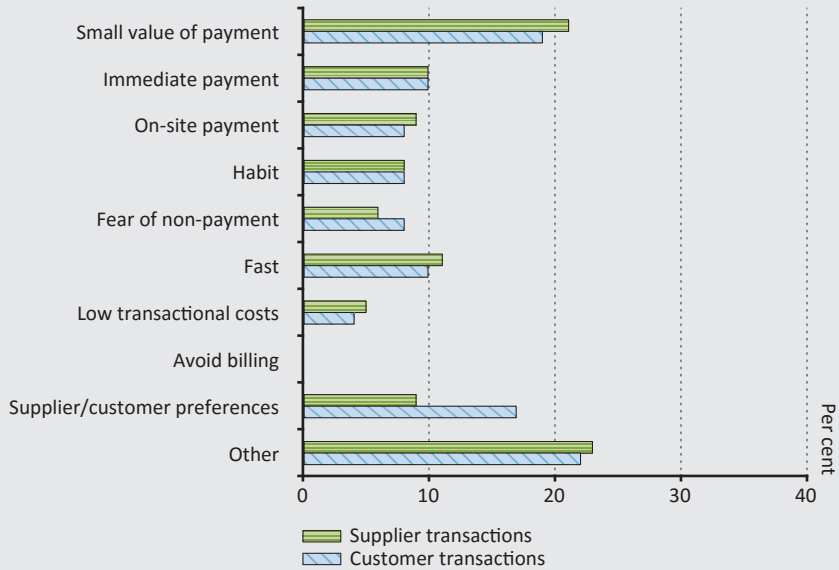
Businesses are required to have a payment account. Contrary to the population, therefore, access to banking services and the existence of bank relations are inevitable in their case. What motivates, then, enterprises to pay their suppliers in cash at the rate observed during the survey, or to accept cash payments? In the quantitative survey, respondents were most likely to identify low value and their customers' preference as the main motive behind the use of cash (*Figures 13 and 14*).[9]

Figure 13
Reasons for cash usage in the supplier and customer relationships of SMEs (%)



[9] Respondents were allowed to indicate several reasons for their cash usage. Since the motives listed were slightly different in the 2013 and 2017 surveys, the results are not fully comparable; therefore, the results received in 2013 were not displayed in the summary figure.

Figure 14
Reasons of cash usage in the supplier and customer relationships of microenterprises (%)



We should note that besides the reasons on the original list, a high percentage of the respondents indicated the "other" category as the motive behind the use of cash. Those selecting the "other" category frequently mentioned, albeit in different words, reasons that can be classified into customer preference (e.g. "private individuals tend to pay in cash", "many customers have no cards"). This indicates that customers' need to use cash is much stronger in reality – especially among retail customers – than the value calculated for customer preference. Customer preference deserves special attention because the cash received by enterprises regularly or continuously from – typically retail – customers may have a spillover effect; indeed, cash revenues are spent – at least in part – on some of the purchases of the enterprise, and the supplier may also use this cash revenue to pay for its own purchases. This could explain the increase in the percentage of enterprises that use cash in supplier relationships and also the rise in the average value of suppliers' cash transactions. The other reasons most cited by respondents – in addition to those belonging to the customer preference category – were simplicity, convenience and the ease of making ad hoc purchases.

It should be pointed out that even though relatively few respondents selected the fear of non-payment from the original list (11 per cent of SMEs and 8 per cent of microenterprises in their customer relationships), quite a few respondents chose uncertainty and distrust from the other reasons that may motivate them to use cash. Even so, a substantial change can be observed in this regard compared to the

result of the 2013 survey: in 2013, 26 per cent of the respondent SMEs reported using cash because of concerns about their customers' non-payment. This can be interpreted as a significant, positive improvement in fair business conduct and trust between enterprises.

Similarly, habit as a motive for cash usage has noticeably weakened since 2013. While at the time of the 2013 survey 18 per cent of SMEs reported using cash out of habit, by 2017 this rate dropped to 5 per cent in the supplier relationships of SMEs and to 6 per cent in their customer relationships, but even among microenterprises this value is only 8 per cent in both payment directions. Although only a negligible fraction of the enterprises cited the avoidance of invoicing (and hence, anonymity) as the reason behind cash usage, the real rate may be higher than that as, even anonymously, respondents are presumably reluctant to reveal their own unlawful conduct.

Although the incentives for the retrenchment of cash payments will be discussed later in the study, at this point we should nevertheless mention two factors. A large number of respondents revealed – both SMEs and microenterprises – that a decline in the costs of electronic payment solutions and the expansion and increased flexibility of electronic banking services would be the strongest incentives for scaling back their cash usage (they were most likely to select these two incentives of those listed in the questionnaire). *These results indicate that cash-user Hungarian enterprises are remarkably open to electronic payment solutions, which is a large step forward compared to 2013.* Based on the evaluation of the status observed at the time of our survey, we can conclude that the selection of electronic banking services currently provided by credit institutions is insufficient to cover and/or unable to meet the demand arising from the side of enterprises. The reduction of this gap could generate a robust shift towards cashless enterprises even in a matter of a few years.

3.4. Trust (distrust), uncertainty, payment discipline

The 2013 survey focused on the trust – or lack thereof – in the B2B relationships of SMEs and on the correlation between payment behaviour and the motives of cash usage. The results indicated that enterprises were acutely aware of the lack of trust or more precisely, their partners' unreliability, which essentially stemmed from the uncertainty surrounding the post-crisis economic environment. The greatest problems were caused by weak payment discipline and the general practice of late (overdue) payments. In order to mitigate the risks arising from late payments and potential non-payments, enterprises curtailed their payment deadlines and routinely demanded instant or even advance cash payments. In preparing for the 2017 survey, the question arose whether this situation had changed after the end of the crisis; therefore, we once again examined the potential correlation between

payment discipline (payment terms, overdue receivables or bad debt losses) and cash usage.

Payment terms may have great economic significance, as small and medium-sized enterprises may often take advantage of longer payment deadlines consistently in order to gain access to liquidity, especially if they have no access to other financing channels, such as short-term bank loans.[10] This phenomenon was simulated by *Burkart and Ellingsen* (*2004*), on the basis of which *Havran et al.* (*2017*) empirically demonstrated that on a sample of Hungarian firms a complementary effect could be observed between short-term bank loans and accounts payable in the period of 2010–2015. Moreover, analysing the data of SMEs across 13 European countries over the period of 2003–2012, *McGuiness et al.* (*2017*) found that enterprises with access to trade credit were less likely to face financial distress during the credit crunch of the economic crisis. With relaxed payment terms, therefore, enterprises with ample liquidity may be able to assist distressed or temporarily insolvent firms. Consequently, we may conclude that it would be desirable in Hungary, as well, if the SME sector relaxed payment terms which, according to the 2013 survey, can be considered rather tight.

However, compared to 2013, we did not find any noticeable change in the payment terms typically applied by enterprises. Most enterprises (44 per cent of both SMEs and microenterprises) are expected by their suppliers to pay within 8–30 days and similarly, most of them (38 per cent of SMEs and 40 per cent of microenterprises) also impose such payment terms on their customers (*Figures 15 and 16*). While SMEs' leeway increased on the supplier side (based on the sample, the percentage of those receiving a deadline of 30, 30–60 and 60–90 days increased somewhat), at a confidence level of 95 per cent only the latter can be considered significant. Only a small fraction of this is passed on to customers; a significant increase can only be observed among those with a 30-day deadline.

A moderate improvement can be observed in the area of instant, simultaneous payment. Albeit slightly, the percentage of SMEs requiring instant payment declined significantly (to 8 per cent from 12 per cent in 2013); however, a high ratio of microenterprises (20 per cent) still demand instant payment from their customers. Since – as we could see – few enterprises use card payment and only seldom at that, we have reason to assume that a large part of instant payments are made in cash.

[10] The international literature refers to this type of financing as "trade credit".

Figure 15
Typically applied payment terms in supplier relationships (%)

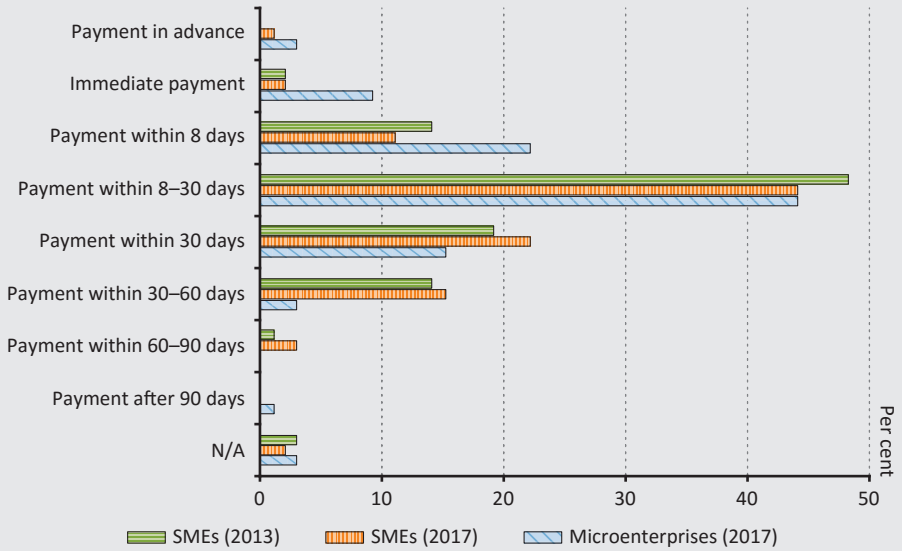
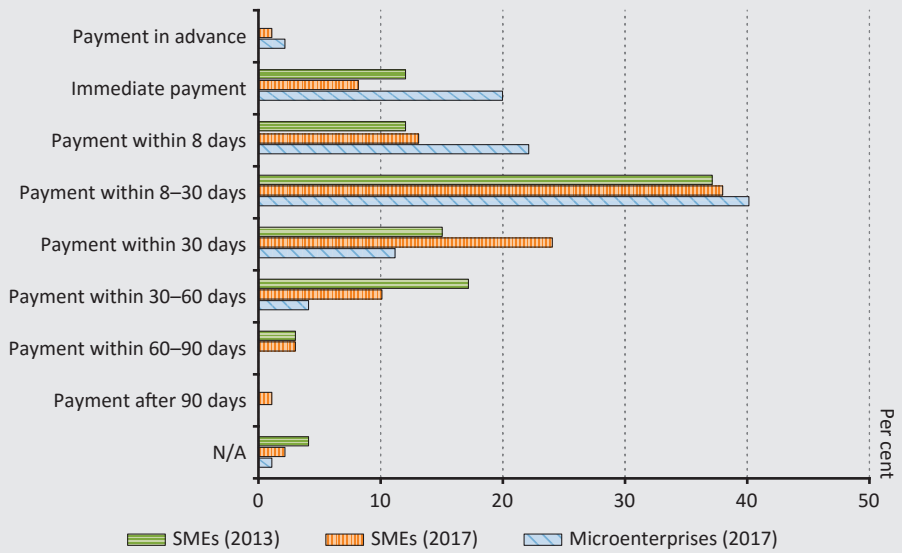


Figure 16
Typically applied payment terms in customer relationships (%)



As demonstrated by the figures, microenterprises face much tighter payment terms in their supplier relationships than SMEs and not surprisingly, they also tend to impose shorter deadlines on their customers. Since the result of the analysis of overdue receivables or bad debts does not justify this kind of discrimination, the tighter payment terms imposed by suppliers on microenterprises are more likely related to their weaker bargaining position than distrust in their willingness to pay.

Microenterprises were less likely than SMEs to report that they currently have overdue accounts payable (10 per cent of microenterprises vs. 21 per cent of SMEs). Examined from the customer side, overdue receivables or bad debts show a more unfavourable picture (60 per cent of SMEs had overdue receivables and 48 per cent incurred bad debt losses over the past three years; in the case of microenterprises these rates are 28 and 31 per cent, respectively). Based on this, we may assume that respondents may have painted a more favourable picture of their own payment behaviour than would be realistic, but this phenomenon may have occurred in both enterprise groups and accordingly, we have no reason to assume that SMEs are more reliable in performing their payment obligations than microenterprises.

Comparing the 2013 survey to the data from the current study (*Figure 17*), we found that the responses to the questions in relation to overdue receivables or bad debts *clearly point to an improvement in payment discipline in the SME sector.* While nearly half of the respondents had overdue receivables in 2013, by 2017 this rate had dropped to less than 20 per cent, and the decline was particularly pronounced in the case of low-value debts (below HUF 1 million).

The answers to the questions concerning bad debt losses also confirm the improvement in payment discipline. Owing to scaling differences, the value of the receivables in 2013 vs. 2017 cannot be compared directly, but we can establish that half of the respondents in 2017 had not faced irrecoverable debts during the past 3 years, compared to 35 per cent in 2013 (*Figure 18*).

Summing up the responses relating to compliance with payment terms and the amount and magnitude of outstanding receivables and bad debts, we can conclude that the *business environment and hence the payment discipline of enterprises has improved significantly in the SME sector. This shift is extremely important for operability and competitiveness, as it may pave the way for corporate growth through improvement in enterprises' operating and liquidity conditions.*

Figure 17
Value of overdue receivables in 2013 and 2017 among SMEs

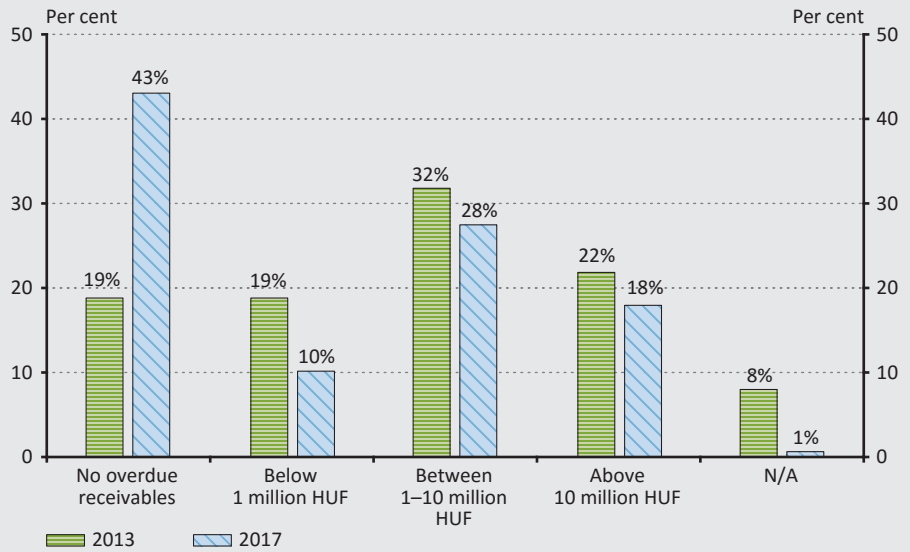
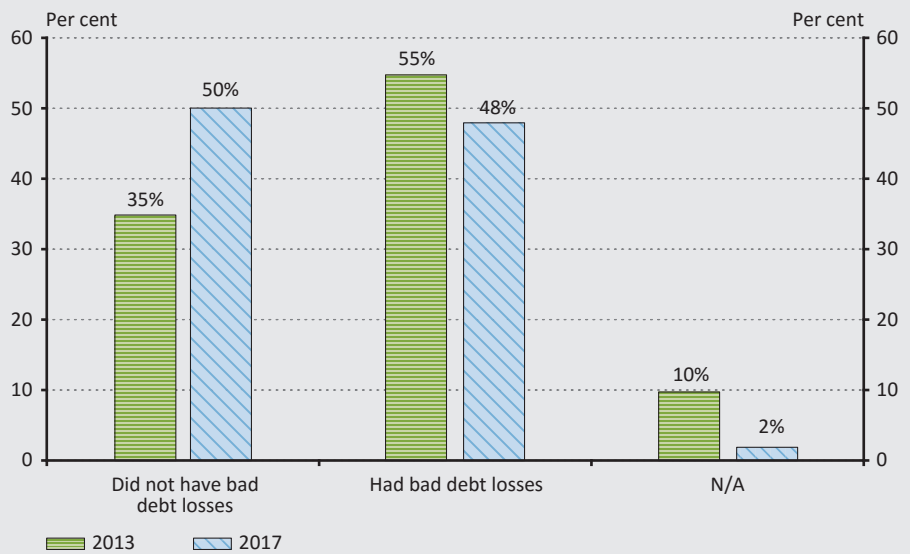


Figure 18
Did the enterprise have bad debt losses in the past 3 years? SMEs replies in 2013 vs. 2017



According to the study entitled *European Payment Report 2017* published by the international credit management company *Intrum Justitia,* payment discipline in Hungary is good, overall, by international standards. Although with 29 participating European countries, their survey not only covered micro, small and medium-sized enterprises, we can still draw important conclusions from its results. According to their Report, average payment terms for B2B transactions are 26–27 days and 11–14 days in business-to-customer (B2C) transactions. These values in the public sector are somewhat more favourable – 27 days – than the European average. Hungarian businesses are forced to write off 2.1 per cent of their annual revenues as bad debt loss, which corresponds precisely to the rate calculated for Europe as a whole.

The most important findings of the study relevant to Hungary can be summed up as follows. It is a generally accepted practice in Hungary among businesses to accept longer-than-ideal payment terms at the request of their customers. 58 per cent of the respondents agree to ease payment terms unconditionally, and this rate is expressly high by European standards. The most common cause for late payments lies in the debtor's financial difficulties. Disputes over settlement or administrative inefficiencies are less common in Hungary. Around 40 per cent of the respondents indicated that late payments curtail company growth to some degree, and 24 per cent thought that faster payments from customers would enable their company to hire more employees.

It can be stated, overall, that the degree of distrust currently present in the Hungarian corporate sector does not exceed the European average; in fact, some indicators lead us to conclude that Hungarian enterprises trust their customers to a higher-than-average degree. Based on our survey, while average payment terms eased only slightly, the share of both late payments and bad debts shows a declining trend All things considered, the view that the main motive behind the still substantial cash usage of Hungarian SMEs and microenterprises is a general sense of distrust appears no longer true in 2017.

3.5. Credit institution preferences, bank switching

Our survey also sought to explore the considerations on the basis of which Hungarian businesses choose their account manager financial institutions, whether they switched banks in the past 3 years and if yes, why. The primary purpose of this exercise was to examine whether dissatisfaction with banking services and the associated costs were among the underlying reasons for cash usage.

According to our results, participating enterprises are extremely loyal to their account manager financial institutions, as only around 15 per cent of them switched banks in the past few years. This rate is roughly the same for SMEs and microenterprises. The primary reasons for the switch for SMEs were cost efficiency, or a more convenient service better tailored to their specific needs and

the availability of a more favourable service package (e.g. account management conditions, borrowing). Nearly half (46 per cent) of those switching banks over the past 3 years were motivated by the former, and around a third of them (30 per cent) by the latter criterion in the switch. To a smaller degree, dissatisfaction with the previous financial institution was also cited as the reason for the switch, and a non-negligible percentage of the respondents were forced to switch banks because of the bank's liquidation or bankruptcy.

Microenterprises also reported that the main reason behind the switch was cost efficiency, or better service combined with a more favourable financial service package; however, the respective rates fall behind those observed among SMEs in the case of both reasons (33 per cent and 22 per cent, respectively). Forced switches due to the bankruptcy or liquidation of the previous financial institution, however, were cited by a higher percentage of the respondents compared to SMEs (20 per cent), and another important factor in their case was the proximity of branches. 11 per cent of the microenterprises switching banks in the past 3 years justified the switch by the shutdown of the nearest branch of the previous account manager financial institution (*Figures 19 and 20*).

Figure 19
Percentage of SMEs switching account manager banks in the past 1–3 years and the main reason for the switch (%)

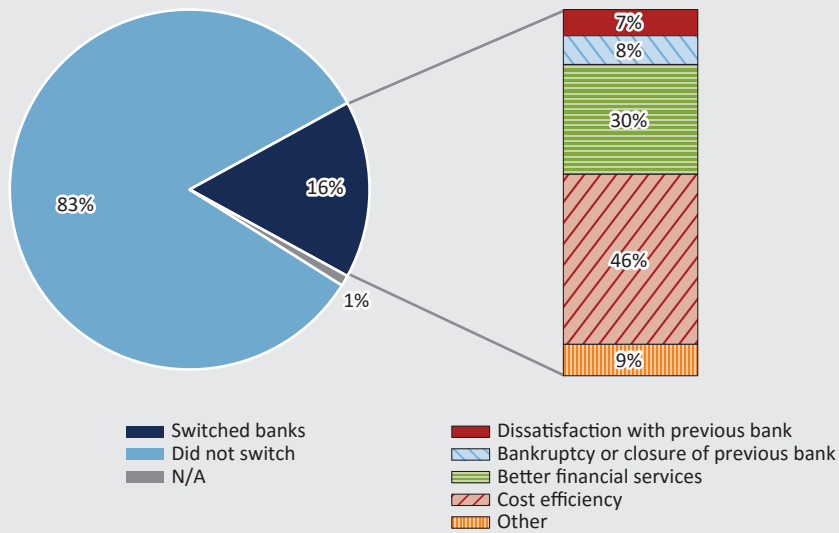
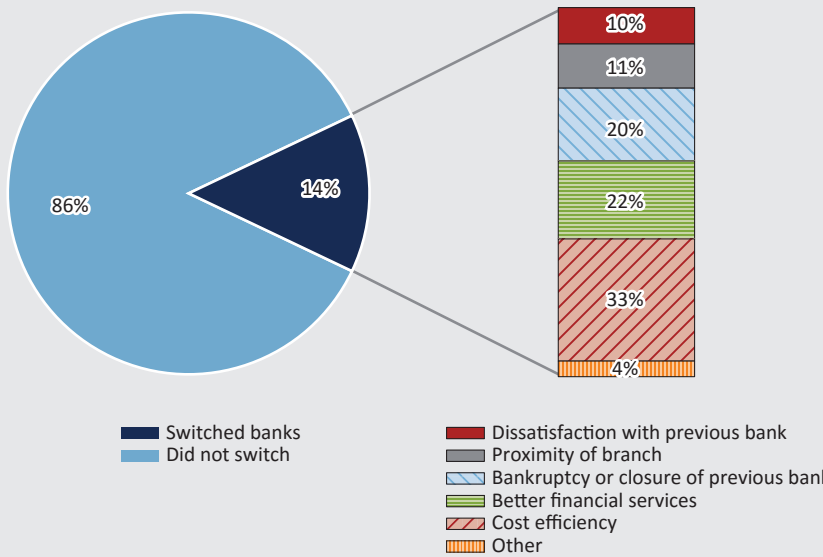


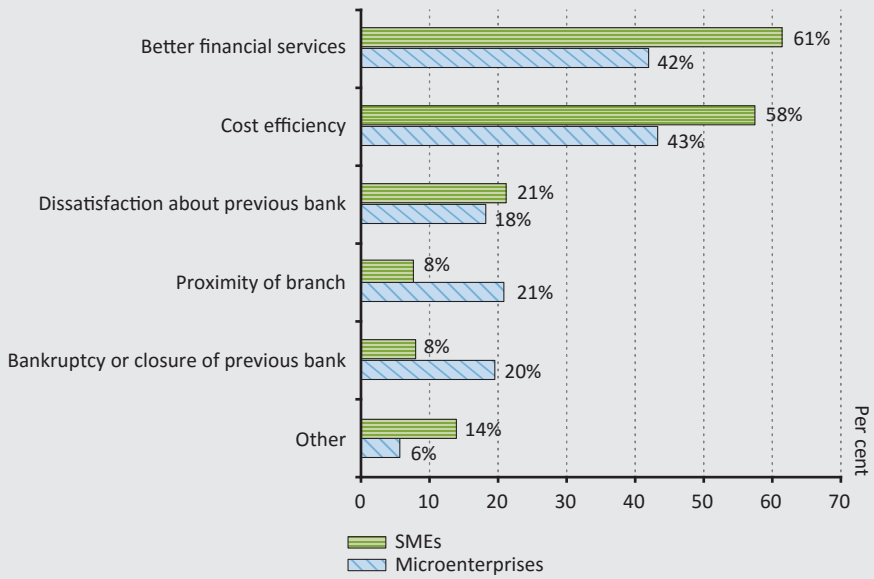
Figure 20
Percentage of microenterprises switching account manager banks in the past 1–3 years and the main reason of the switch (%)



We also asked participants to indicate the secondary reasons for the switch, without limiting the number of answers that could be given. Around half of the respondents cited at least one secondary reason among both SMEs and microenterprises. In both cases, respondents typically mentioned personalised service and the availability of a more favourable service package. In addition, they also cited cost-efficiency, dissatisfaction with the previous account manager and easier access to the branch of the new bank (proximity, opening hours).

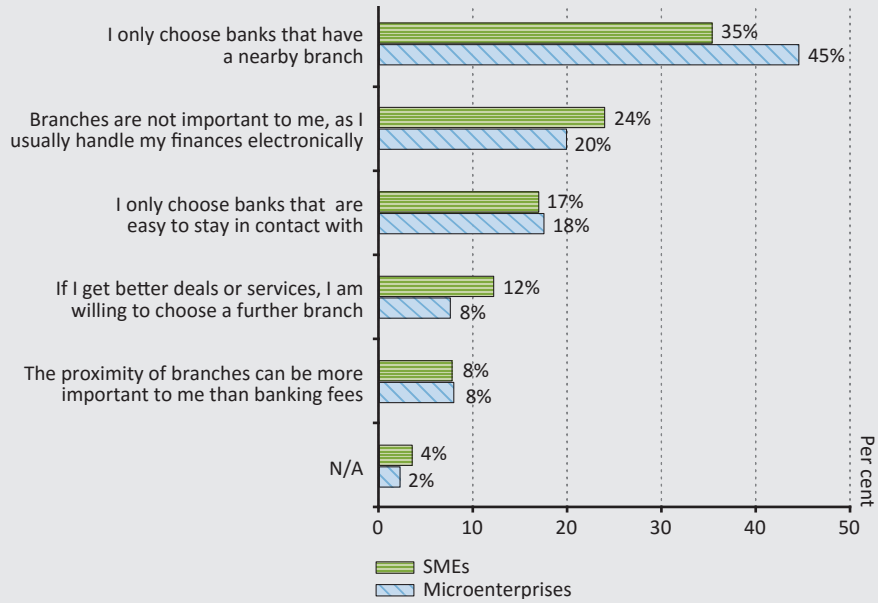
Aggregating the answers given to these two questions reveals the percentage of enterprises whose decision was motivated by the respective consideration (*Figure 21*). Based on our results we found, overall, that the most typical motivations for switching banks were cost efficiency, personalised service or a more favourable financial service package. These considerations are more important for SMEs; accordingly, around 60 per cent of SMEs and 40 per cent of microenterprises reported that these aspects played a role in their decision. It should be noted that, based on the replies, bank switching was associated with dissatisfaction with the previous financial institution in only about 20 per cent of the cases. 17 of 80 respondents switching banks identified this as either the primary, or the secondary reason in the case of SMEs, while the corresponding rates among microenterprises were 72 and 13 per cent, respectively. Microenterprises were more likely to indicate proximity and access to branches as the reason for switching banks: 21 per cent of the relevant respondents were motivated by these considerations.

Figure 21
Percentage of respondents considering the given criterion among those switching banks in the past 1–3 years (%)



The bank selection preferences of the enterprises were examined with the assistance of another question, where respondents were asked to pick two statements out of five with which they agree most regarding access to branches (*Figure 22*). The most popular statement among both SMEs and microenterprises was the one that said *"I only choose a financial institution that has a branch near my registered office/site"*. 45 per cent of microenterprises picked this statement compared to a slightly lower percentage of SMEs (35 per cent), which confirms our previous assumption that proximity to branches is a more important consideration for microenterprises. This assumption is supported further by the fact that 12 per cent of SMEs are willing to choose a more distant branch in exchange for better fees or conditions, while this rate is only 8 per cent among microenterprises.

Figure 22
Which statement do you agree with the most? (%)

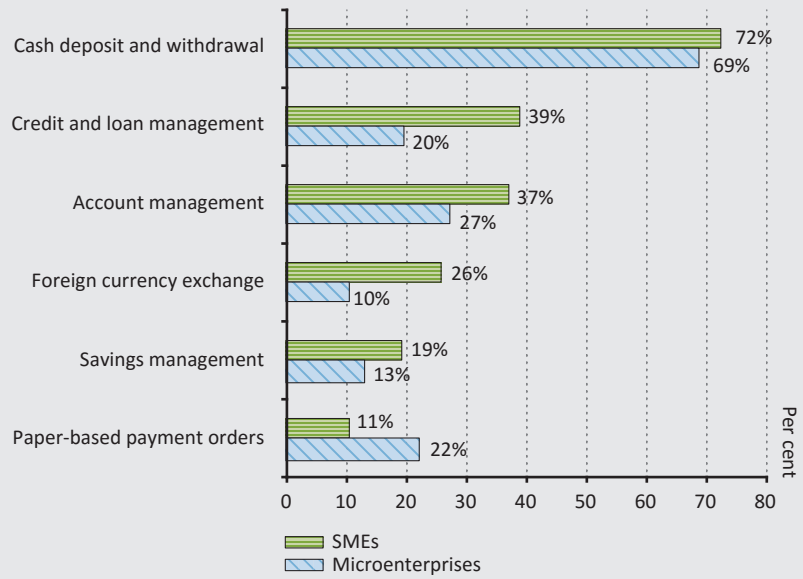


8 per cent of the respondents of both types of enterprises considered access to branches critical, and were even willing to pay higher account management fees in return. A higher percentage of the respondents reported that branches held no relevance for them, as they perform most of their transactions electronically (SMEs: 24 per cent, microenterprises: 20 per cent). Roughly the same percentage indicated that smooth contact with the branch was the most important consideration, but added that the branch's physical proximity to the enterprise's place of business or site was not necessarily required for this (SMEs: 17 per cent, microenterprises: 20 per cent).

We also asked respondents what types of transactions they typically sought to execute when visiting their account manager branch (*Figure 23*). Both SMEs and microenterprises typically reported visiting the branch for pay-ins or pay-outs; 70 per cent reported making a cash deposit or withdrawing cash from their accounts on these occasions. SMEs were also likely to mention credit administration or other account operations (e.g. management of authorisations): both purposes were cited by almost 40 per cent of the respondents. The former two transaction types are also important for microenterprises, although their share is somewhat smaller, 20 per cent and 27 per cent, respectively. In addition, more than 20 per cent of microenterprises also initiate paper-based credit transfers during personal visits to their branch.

On balance, we found that Hungarian SMEs and microenterprises are extremely loyal to their banks; indeed, excluding forced bank switches, only slightly more than 10 per cent of the respondents switched account manager financial institutions in the past 3 years. Even though most respondents indicated cost-efficiency as the primary reason for switching banks, we cannot say that Hungarian enterprises are particularly sensitive to cost: the quality of banking services is also considered by most before making such a decision.

Figure 23
Types of transactions executed in account manager branches Frequency of specific transaction types (%)



It is another important message gleaned from the survey that the *significance of branches from a payment perspective is on the decline in the SME sector;* only about 40 per cent of the respondents referred to the importance of easy access to the branch network. By contrast, for more than half of the microenterprises proximity to the account manager bank's branch is still a key criterion in bank selection. Pay-in and pay-out transactions clearly represent the most typical activity performed in the branch; in addition, enterprises are likely to visit their bank for credit administration or for other account operations, while microenterprises still visit their branches for paper-based credit transfers relatively frequently.

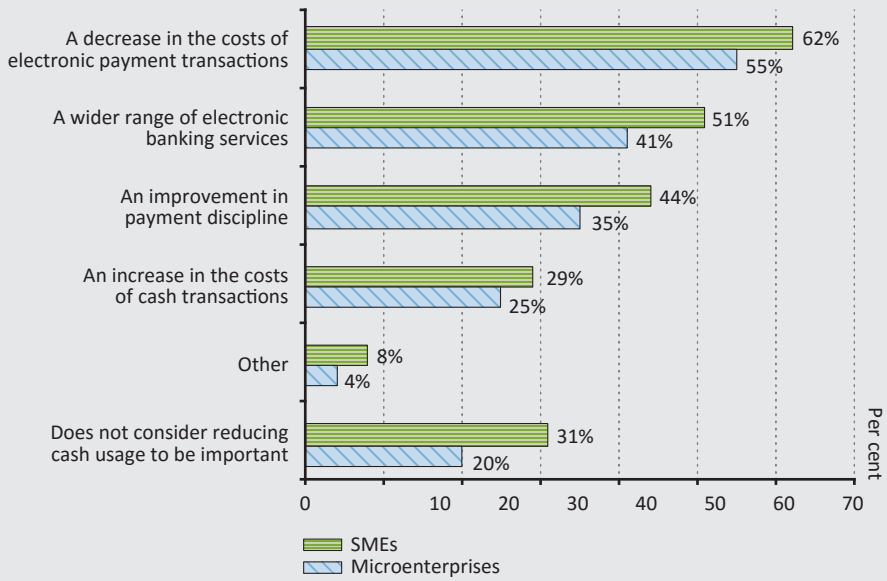
3.6. How can enterprises' cash usage be retrenched?

Respondents were asked what would be an incentive for them to replace cash transactions by electronic payment solutions. Although a fairly high percentage of enterprises (31 per cent of SMEs and 20 per cent of microenterprises) reported that the reduction of cash usage was not an important consideration for them and thus, they ignored this issue altogether, the majority of the respondents indicated that they could retrench cash usage primarily in response to positive incentives. Respondents were allowed to pick more than one of the options offered and also to formulate other incentives during the oral interviews in their own words. *Enterprises would be most open to the reduction of the costs associated with electronic payment solutions and to the expansion and improvement in the flexibility of electronic banking services* (*Figure 24*). In fact, these possibilities would encourage enterprises even more so than indicated in the figure, given that many of the incentives identified by respondents choosing the "other" category included proposals that can be classified in these categories (e.g. "cheaper credit transfers", "technical improvement on the bank side", "speeding up the four-hour transaction time, even real-time transfers", "revision of transaction taxes").

It is important to emphasise that, based on the results of our survey, a potential increase in the costs of cash transactions would be a far less successful and effective incentive in the efforts to reduce cash usage than positive incentives. The percentage of those who believe that increasing the costs of cash transactions would scale back their use of cash (29 per cent of SMEs and 25 per cent of microenterprises) is less than half of those who believe that reducing the costs of electronic payment solutions would achieve the same result (62 per cent of SMEs and 55 per cent of microenterprises).

Respondents with a high share of cash transactions in their payments who also consider the reduction of cash usage important would be typically most motivated to do so by the reduction of the costs associated with electronic payments. At the same time, however, this segment was no more likely to switch account manager financial institutions over the past 3 years than the total sample. Mainly because of the small size of the relevant sample, in this article we are unable to offer a more detailed analysis of any other common features of the enterprises that belong to the above segment; nevertheless, this would be an important element of further research due to its strong potential to encourage the reduction of cash usage on the part of those who use cash out of necessity.

Figure 24
Susceptibility to the incentives of cash usage reduction among enterprises (%)



Presumably, enterprises' preference for cash usage may be related to the presence of the shadow economy. This survey, however, was not intended to examine this relationship in more detail and our methodology is not suitable for such purposes in any event. The topic has been addressed in detail both by Hungarian and foreign authors (for example, *Rogoff 1998*, *Bajada – Schneider 2005*, *Semjén et al. 2009*), who confirmed the existence of this relationship, namely, that cash is one of the elements that fuels the operation of the shadow economy.

3.7. Cash usage correlations

Although our small sample size limits our ability to perform more complex statistical analyses, we attempted to identify – through regression analysis – which criteria among those we examined may most strongly influence the cash usage of enterprises (separately for SMEs and microenterprises). Since presumably it is not only corporate considerations but also customer preferences that play a role in choosing the payment method of transactions conducted with customers, for the rest of our article we focus our analysis of enterprises' cash usage primarily on the data of supplier relationships. We separately analyse the attributes that affect the cashless operation of enterprises and the percentage thereof in the case of cash users because according to our hypothesis, the correlations behind these two phenomena might be, to some degree, different.

The dependent variable of our regression estimate in the case of cash-user enterprises is the percentage of cash payments in the enterprise's supplier relationships, while its explanatory variables in the case of microenterprises comprise the percentage of cash payments in the customer relationships of the given enterprise, the dummy variables that classify 2016 sales revenues (using the largest sized group as a benchmark), and an additional dummy variable with a value of 1 if the respondent switched the account manager bank in the past 3 years. In the case of the SME sector two additional dummy variables are used, which capture whether, in the respondent's opinion, it was the introduction of intraday transactions or the adoption of the financial transaction levy that affected the operation of the respondent's enterprise the most (the relevant questions were only included in the questionnaires completed by representatives of small and medium-sized enterprises).

Table 1
Estimated coefficients of the regressions explaining the cash usage of the SME sector and microenterprises

SME sector		Microenterprises	
Percentage of cash payment in customer relationships (%)	0.29*	Percentage of cash payment in customer relationships (%)	0.56*
2016 sales revenue (HUF 200–500 million)		**2016 sales revenue (HUF 0–25 million)**	
HUF 0–100 million	19.53*	HUF 25–50 million	–11.16*
HUF 100–200 million	8.85*	HUF 50–100 million	–15.50*
HUF 500–1,000 million	–0.21	above HUF 100 million	–23.99*
above HUF 1,000 million	–7.78*	Changed its account manager bank in the past 3 years	7.07*
Introduction of intraday transactions affected the operation of the enterprise	–6.41*	Constant	20.68*
Introduction of the financial transaction levy affected the operation of the enterprise	2.78	N	273
Changed its account manager bank in the past 3 years	6.27	R^2	0.50
Constant	11.44*		
N	263		
R^2	0.41		

*Note: * Indicates coefficients significant at a 95 per cent confidence level*

The suspicion of multicollinearity may have arisen in the case of the model as the factors that are significant with regard to supplier-side cash usage may also correlate with cash usage on the customer side. However, since the value of VIF indicators[11] is below 2 for each variable we can exclude any bias.

[11] Variance Inflation Factor: it measures the ratio of the actual variance of the given variable's estimated coefficient to the value that would be received with the total exclusion of multicollinearity.

The coefficients presented in *Table 1* confirm our previous hypothesis that cash inflows from the customer side spill over to supplier relationships, in particular, in the case of microenterprises. Moreover, it is true for both small and medium-sized enterprises and microenterprises that the higher the revenues of an enterprise, the less likely it will be to pay its suppliers in cash. As regards regulatory measures, we found that the percentage of cash transactions is 6.41 per cent lower on average among those respondents who reported that the introduction of intraday transactions affected the operations of the enterprise. Cash transactions in supplier relationships occurred at a higher percentage at microenterprises that switched account manager banks in the past 3 years, which may indirectly suggest that in their case, the use of cash can be attributed to the high costs of electronic payment solutions. As there was no significant relationship between the share of cash usage of the enterprise and the other attributes analysed in our survey (e.g. number of employees, core activity, payment terms, account management costs in the past few years), the model presented above does not include these attributes.

We relied on logistic regression to determine the extent to which specific factors influence cashless operation on the supplier side, as the dependent variable can take two values (1: cashless or 0: cash user). The explanatory variables in this case comprise the dummy variable that expresses cashless operations in customer relationships and the 2016 sales revenue, as well as the dummy variables classifying the core activity of the enterprise (using the largest sized group as a benchmark).

Table 2
Estimated coefficients of the regressions explaining the cashless operation of the SME sector and microenterprises

SME sector		Microenterprises	
Cashless in customer relationships	2.17*	Cashless in customer relationships	2.26*
2016 sales revenue (HUF 200–500 million)		**2016 sales revenue (HUF 0–25 million)**	
HUF 0–100 million	0.28	HUF 25–50 million	0.58*
HUF 100–200 million	0.00	HUF 50–100 million	0.2
HUF 500–1,000 million	–0.01	above HUF 100 million	–0.13
above HUF 1,000 million	0.81*	**Core activity of the enterprise (Other)**	
Core activity of the enterprise (Other)		Construction	–1.24*
Construction	–0.82*	Trade	–0.27
Trade	0.71*	Manufacturing	–0.29
Manufacturing	0.13	Constant	–1.30*
Constant	–1.53*	N	487
N	477	R^2	0.20
R^2	0.19		

*Note: * Indicates coefficients significant at a 95 per cent confidence level*

The estimated coefficients presented in *Table 2* can be interpreted as log-odds rates; in other words, they show the extent to which the existence of the given attribute increases (in the case of a positive coefficient) or decreases (in the case of a negative coefficient) the probability rate of cashless operations in supplier relationships compared to the benchmark group. We found, therefore, that enterprises that are cashless in customer relationships are also more likely to execute transactions towards their suppliers electronically, and that similarly, enterprises with higher revenues are more likely, to a certain degree, to operate without cash. It is also important that we found a significant correlation between cashless operation and the core activity of the enterprise: participants of the construction industry are less inclined to stop using cash, whereas small and medium-sized enterprises engaged in trade are more likely to exclusively use electronic payment.

In addition, we thought that analysing the attributes of wage payments in cash was also warranted. As such payments may indirectly influence households' payment habits as well, understanding this phenomenon may play an important part in mapping the role of cash in the Hungarian economy. The dependent variable of the regression estimated for this was the percentage of cash-based wage payments, and its explanatory variables comprised the share of cash payment in supplier relationships and the dummy variables classifying the 2016 sales revenue of the enterprise and its core activity (using the largest sized group as a benchmark). Since the VIF coefficients were below 2 for each variable, the model does not include any multicollinearity.

Table 3
Coefficients of the regression explaining cash-based wage payments in the SME sector

	SMEs
Percentage of cash payment in supplier relationships (%)	0.30*
2016 sales revenue (HUF 200–500 million)	
HUF 0–100 million	15.57*
HUF 100–200 million	3.10
HUF 500–1,000 million	–5.53
above HUF 1,000 million	–11.91*
Core activity of the enterprise (Other)	
Construction	8.71*
Trade	1.53
Manufacturing	0.97
Constant	12.50*
N	469
R^2	0.18

*Note: * Indicates coefficients significant at a 95 per cent confidence level*

The coefficients presented in *Table 3* demonstrate that, in the SME sector, enterprises preferring the use of cash in supplier transactions also tend to pay wages in cash, and cash-based wage payments are particularly prevalent among the enterprises with the lowest revenues. We can also observe a correlation with the core activity of the enterprise: a higher percentage of the enterprises engaged in construction pay wages in cash. In the case of microenterprises, no significant relationship could be observed between cash-based wage payment and the other attributes we examined.

4. Main conclusions

Our study presented the results of the explorative survey conducted among Hungarian micro, small and medium-sized enterprises. The survey was mainly intended to review the cash usage of Hungarian enterprises and to gain a deeper understanding of their payment behaviour. Wherever it proved to be substantiated methodologically, we compared our findings with the results of the survey conducted in 2013 with a similar focus in order to analyse changes in the enterprises' attitude to cash usage and accordingly, in the payment habits they exhibited in business relations. The main findings of our research were the following:

- *The most typical payment method among Hungarian micro, small and medium-sized enterprises is credit transfer:* most enterprises rely on this payment method in their business relations, in supplier and customer positions alike.

- Despite the clear dominance of bank transfers, we found that the *use of cash still has a strong presence among Hungarian SMEs and microenterprises – especially in the case of low-value transactions and those exceeding HUF 500,000* – without any decline in its role and significance in the past four years.

- Despite the dynamic development in the cashless infrastructure, *in certain areas we observed an unfavourable shift in the cash payment practice of SMEs compared to the 2013 survey:* the percentage of enterprises using cash in supplier transactions increased, and there was also an increase in the number of enterprises that used cash for large-value transactions both in their supplier and customer relationships. At the same time, our regression analysis confirmed our initial hypothesis; namely, that cash usage declines in line with the increase in enterprise size.

- In addition to cash payments used in B2B relationships, we should stress that the respondent enterprises – in particular, microenterprises – also pay a large percentage of wages in cash, which generates further cash usage in B2C relationships.

- Most enterprises justified their use of cash by executing low-value transactions, but the increase in the share of high-value cash transactions appear to contradict this statement somewhat. The results of the survey are much more likely to suggest that *the use of cash is more like a deep-rooted attitude in the operation of the enterprises.* Many of them resort to cash usage out of habit, and cash payment is still the simplest payment method in on-the-spot payments. Accordingly, cash inflows – typically from the customer side – proceed "unhindered" through the business relations of the enterprises and find their way back to an enterprise's bank account partially only or after having reversed directions several times.

- The research results received in the area of payment behaviour (payment discipline, observation of payment terms, overdue receivables and bad debts) clearly indicate that the *business environment and hence payment discipline of enterprises has improved significantly in the SME sector.* This shift is a clear positive message with regard to the operability and growth potential of the SME sector. It also suggests that the general distrust observed among the enterprises in the wake of the crisis has moderated, and the signs of this moderation are now also reflected in the payment discipline of the enterprises. The lack of trust that can now be observed primarily in customer relationships is far less likely to justify the use of tight payment terms and cash payments among SMEs.

- *Micro, small and medium-sized enterprises are extremely loyal in their bank relations; bank switching among them is remarkably rare.* It is a positive shift that *SMEs are far more open to electronic payment solutions than four years ago.* Most cash-user enterprises would be willing to reduce the use of cash if electronic payment solutions and the related banking services were available more inexpensively, flexibly, and in a way more tailored to their personal needs (more than twice as many enterprise would be willing to restrain their cash usage in response to the reduction of the costs associated with electronic payment solutions than those doing the same in response to an increase in the costs of cash transactions). Nevertheless, our data suggest that the percentage of those willing to switch banks to that end is far lower.

- Based on our research it is a reasonable assumption that *there is significant demand for the introduction of broadly available, inexpensive, instant payment solutions,* which could be also used in situations where currently cash payment represents the only real alternative. This assumption is supported by the fact that around one quarter of the enterprises replaced some of their cash payments by electronic credit transfers after the introduction of intraday transactions.

- There is no evidence for a direct relationship between the financial transaction levy and the enterprises' use of cash; however, the levy presumably plays an indirect role in the fact that transaction costs are perceived as high by the

respondents. As a further consequence, enterprises may also use their cash inflows in their supplier relationships.

- The payment habits of the SME sector are expected to change – perhaps significantly – in the coming years as a result of the introduction of the system of "online invoicing" as from 1 July 2018 (i.e. mandatory data supply to the National Tax and Customs Administration on electronically issued invoices within a 24-hour time limit) and as a result of the instant payment system infrastructure to be implemented, in accordance with the MNB's decision, by GIRO Zrt. by the second half of 2019, which guarantees that transactions are cleared within 5 seconds every day of the year.

References

Bajada, C. – Schneider, F. (Eds.) (2005): *Size, Causes and Consequences of the Underground Economy: An International Perspective.* Ashgate, Aldershot, United Kingdom.

Banai, Á. – Körmendi, Gy. – Lang, P. – Vágó, N. (2016): *Modelling the credit risk of the Hungarian SME sector*. MNB Occasional Papers 123. http://www.mnb.hu/letoltes/mnb-op-123-final.pdf. Downloaded: 18 January 2018.

Bethlendi, A. – Végh, R. (2014): *Crowdfunding – could it become a viable option for Hungarian small businesses?* Financial and Economic Review, 13(4): 100–124. http://english.hitelintezetiszemle.hu/letoltes/5-bethlendi-vegh-en.pdf

Bódi-Schubert, A. (2014): *Bizalom és fizetési magatartás a kis- és középvállalatok üzleti kapcsolataiban* (*Trust and payment behaviour in the business relations of small and medium-sized enterprises*). MNB Occasional Papers 110. http://www.mnb.hu/letoltes/mt110-vegleges.pdf. Downloaded: 12 January 2018.

Burkart, M. – Ellingsen, T. (2004): *In-Kind Finance: A Theory of Trade Credit*. American Economic Review, 94(3): 569–590. https://doi.org/10.1257/0002828041464579

Esselink, H. – Hernández, L. (2017): *The use of cash by households in the euro area*. ECB Occasional Paper Series, No. 201. https://www.ecb.europa.eu/pub/pdf/scpops/ecb.op201.en.pdf. Downloaded: 18 January 2018

Havran, D. – Kerényi, P. – Víg, A. (2017): *Trade Credit or Bank Credit? – Lessons Learned from Hungarian Firms between 2010 and 2015*. Financial and Economic Review, 16(4): 86–121. http://doi.org/10.25201/FER.16.4.86121

HCSO (2017): *A kis- és középvállalkozások helyzete hazánkban 2016* (*The status of small and medium-sized enterprises in Hungary 2016*). http://www.ksh.hu/docs/hun/xftp/idoszaki/pdf/kkv16.pdf. Downloaded: 12 January 2018.

Ilyés, T. – Takács, K. – Varga, L. (2014): *Changes in the fees on payment services and the structure of payments following the introduction of the financial transaction tax*. MNB Bulletin, March: 40–48. https://www.mnb.hu/letoltes/ilyes-takacs-varga.pdf. Downloaded: 15 January 2018.

Ilyés, T. – Varga, L. (2015): *Show me how you pay and I will tell you who you are – Socio-demographic determinants of payment habits*. Financial and Economic Review, 14(2): 25–61. http://english.hitelintezetiszemle.hu/letoltes/2-ilyes-varga-en.pdf

Intrum Justitia (2017): *European Payment Report 2017.* https://www.ijcof.fr/globalassets/countries/france/pdfs/epr-2017.pdf. Downloaded: 12 January 2018.

McGuiness, G. – Hogan, T. – Powell, R. (2018): *European trade credit use and SME survival*. Journal of Corporate Finance, 49 (April): 81–103. https://doi.org/10.1016/j.jcorpfin.2017.12.005

MNB (2018): *Payment Systems Report 2018.* http://www.mnb.hu/letoltes/payment-systems-report-june-2018-vegleges.pdf. Downloaded: 20 June 2018.

Rogoff, K. (1998): *Blessing or curse? Foreign and underground demand for euro notes*. Economic Policy, 13(26): 261–303. https://doi.org/10.1111/1468-0327.00033

Semjén, A. – Tóth, I. J. – Medgyesi, M. – Czibik, Á. (2009): *Adócsalás és korrupció – lakossági érintettség és elfogadottság* (*Tax evasion and corruption: Population involvement and acceptance*). In: Semjén, A. – Tóth, I. J. (eds.): Rejtett gazdaság - Be nem jelentett foglalkoztatás és jövedelemeltitkolás – kormányzati lépések és a gazdasági szereplők válaszai (Hidden economy Undeclared employment and non-reported income: Government policies and the reaction of economic agents). Institute of Economics Discussion Papers, pp. 228–258. Hungarian Academy of Sciences. Budapest.

Tu, T. – Salmon, C. (2016): *Uses of Cash and Electronic Payments.* https://assets.publishing.service.gov.uk/government/ uploads/system/uploads/attachment_data/file/557331/Uses_of_Cash_and_Electronic_Payment.pdf. Downloaded: 16 January 2018.

Annex

Structure of the quantitative questionnaire applied for the survey on the payment habits of Hungarian micro, small and medium-sized enterprises

1. Questions on company demographics (core activity, staff number, net sales revenues), the respondent's position at the enterprise

2. Payment habits in supplier relationships

- Payment methods applied by the enterprise in supplier relationships (multiple choice question allowing multiple answers: cash payment; credit transfer; card payment; other, namely)
- Rate at which the enterprise applies specific payment types (as a percentage of all payment transactions)
- Typical average value of specific cash payment transactions (multiple choice: below HUF 50,000; HUF 50,000 – 100,000; HUF 100,001 – 500,000; above HUF 500,000)
- Reason for the use of cash in supplier relationships at the enterprise (multiple choice question allowing multiple answers: low value; simultaneous exchange of goods and money; the only way for on-the-spot payments; habit; fear of non-payment; quickness; inexpensiveness (low transaction cost); possibility of avoiding invoicing; suppliers prefer to execute their transactions in cash; other, namely)
- Typical payment terms of business transactions with suppliers (multiple choice: advance payment of the full purchase price is required; instant, simultaneous cash payment; payment terms of 8 days or less; payment terms between 8 and 30 days; payment terms of 30 days; payment terms between 30 and 60 days; payment terms between 60 and 90 days; payment terms of more than 90 days)
- Does the enterprise have any overdue supplier accounts at present and if yes, in what amount (multiple choice: below HUF 1 million; HUF 1–5 million; HUF 5–10 million; above HUF 10 million)

3. Payment habits in customer relationships

- Payment methods applied by the enterprise in customer relationships (multiple choice question allowing multiple answers: cash payment; credit transfer; card payment; other, namely)
- Rate at which the enterprise applies specific payment types (as a percentage of all payment transactions)

- Typical average value of specific cash payment transactions (multiple choice: below HUF 50,000; HUF 50,000 – 100,000; HUF 100,001 – 500,000; above HUF 500,000)
- Reason for the use of cash in customer relationships at the enterprise (multiple choice question allowing multiple answers: low value; simultaneous exchange of goods and money; the only way for on-the-spot payments; habit; fear of non-payment; quickness; inexpensiveness (low transaction cost); possibility of avoiding invoicing; customers prefer to pay in cash; other, namely)
- Typical payment terms applied by the enterprise in sale transactions to customers (multiple choice: advance payment of the full purchase price is required; instant, simultaneous cash payment; payment terms of 8 days or less; payment terms between 8 and 30 days; payment terms of 30 days; payment terms between 30 and 60 days; payment terms between 60 and 90 days; payment terms of more than 90 days)
- Does the enterprise apply different payment conditions for old and new customers and if yes, how (multiple choice: payment conditions are tighter for new customers; payment conditions are less tight for new customers)
- Do the following criteria play a role in determining the payment conditions for new customers (yes/no, if yes, more than one answer can be chosen): the new customer's market reputation; recommendations of debt rating agencies; the payment conditions are subject to negotiation; other, namely
- Did it happen in the past three years that the enterprise changed its payment conditions in an existing customer relationship (yes/no) and if yes, how (multiple choice: it typically *tightened* payment conditions; it typically *eased* payment conditions)
- How typical it is for the enterprise to consider assessments by debt rating or debtor rating agencies in formulating its payment conditions for customers (multiple choice: they are regularly considered; they are considered occasionally or as needed; they do not consider such assessments)
- Does the enterprise have overdue account receivables at present (yes/no) and if yes, in what amount (multiple choice: below HUF 1 million; HUF 1–5 million; HUF 5–10 million; above HUF 10 million)
- Did the enterprise have any bad debt loss in the past three years (yes/no) and if yes, in what total amount (multiple choice: below HUF 1 million; HUF 1–5 million; HUF 5–10 million; above HUF 10 million)

4. Typical payment habits in the payment of utility bills and wages

- Payment methods typically applied by the enterprise for the payment of utility bills (multiple choice allowing multiple answers: cash payment; postal inpayment money order ("yellow cheque"); credit transfer; direct debit; other)
- At what rate does the enterprise pay employees' wages in cash and in credit transfer (in percentages, exclusively in relation to wages without any cafeteria, passes and other benefits; in the case of variable wages calculated for an average month)

5. Impact of regulatory measures (intraday transaction, financial transaction levy), incentives for the reduction of cash usage

- Is there any perceivable significance of the availability of intraday transactions for the enterprise (yes/no) and if yes, are the following statements true for the enterprise in the respondent's opinion (true/untrue): it simplified the execution and controllability of payment transactions; it yielded liquidity and cost efficiency benefits; it made the execution of bank transfers faster and more convenient; it was able to replace cash transactions by electronic credit transfers; other, namely
- Did the account management fees of the enterprise change in the past 1–3 years (yes/no) and if yes, how (multiple choice: they increased moderately; they increased significantly; they decreased moderately; they decreased significantly)
- In the respondent's opinion did the financial transaction levy change the enterprise's payment practice (yes/no) and if yes, how (multiple choice question allowing multiple answers: the enterprise tries to consolidate individual electronic payments to partners in order to reach the upper limit of the levy; it performs a higher percentage of e-payments via foreign banks; it chose a bank service where the financial institution assumes a portion of the transaction levy; it performs more outgoing payments in cash rather than electronically; more incoming payments are received in cash rather than electronically; other, namely)
- Would the factors listed below encourage the enterprise to replace cash transactions by electronic payment solutions (yes/no, multiple answers are allowed: an increase in payment discipline between the enterprises; a decline in the costs (e.g. merchant service fees, account management fees, transaction fees) of electronic payment solutions; an increase in the cost of cash transactions; an expansion in electronic bank services and their increased flexibility; other, namely; the respondent does not consider the reduction of cash payments important)

6. The enterprise's credit institution relations, bank selection, bank switching

- Did the enterprise change its account manager financial institution in the past 1–3 years (yes/no) and if yes, what was the *main* reason behind this step (multiple choice: cost efficiency; more convenient and personalised service; more favourable financial service package (e.g. terms and conditions of account management); dissatisfaction with the previous financial institution; customer relations, the service was unsatisfactory at the previous financial institution; proximity; opening hours; other, namely)

- If the switch was justified by *other* reasons in addition to the *main* reason, what was it (multiple choice: cost efficiency; more convenient service tailored to the enterprise's needs; more favourable financial service package (e.g. terms and conditions of account management); dissatisfaction with the previous financial institution; customer relations, the service was unsatisfactory at the previous financial institution; proximity; opening hours; other, namely)

- In selecting the account manager financial institution, several factors may be of significance. Which of the following statements does the respondent agree with the most: I only choose a financial institution that has a branch near my registered office/site; the proximity of the branch network is even more important to me than account management fees; if I get better bank fees or services I am willing to maintain a relationship with a branch even in a more distant city/district; I only choose a financial institution with which I can keep in touch smoothly; branches have no significance to me – for the most part, I handle my account transactions electronically

- If the respondent visits the account manager branch of its enterprise, what type of transactions does he typically execute (multiple choice question allowing multiple answers: cash pay-ins and pay-outs; currency exchange services; placing paper-based credit transfer orders; other account operations (e.g. management of authorisations); administrative tasks related to savings; credit administration)

Depositors' Behaviour in Times of Mass Deposit Withdrawals*

Hubert János Kiss

Based on empirical and experimental data, the study provides an overview of the literature on the behaviour of depositors. On this basis, it establishes that depositors' decisions and thus the phenomenon of mass deposit withdrawals can be explained by fundamental problems as well as coordination among depositors. It points out that depositors' heterogeneity matters, and the impact of individual characteristics depends on the existence of fundamental problems. Characteristics (such as education, financial sophistication, wealth, bank experience and connections) that make it likely that a depositor collects information on the bank reduce the chance of mass deposit withdrawal in the absence of fundamental problems, but increase the chance of mass deposit withdrawal in the case of such problems. The effect of social networks (and of the information flowing through such) also matters. Deposit insurance reduces the probability of bank runs, but is unable to eliminate them completely. Experimental findings are also in line with empirical experiences.

Journal of Economic Literature (JEL) codes: C91, D8, G4, G21,

Keywords: bank run, depositor's decision, empirical data, experiment, panic

1. Introduction

In 1907, exactly 100 years before the most recent major economic crisis, another financial crisis shook the US economy. It was mainly felt in New York, where the stock exchange fell by nearly 50 per cent compared to the previous year, and depositors withdrew their money from banks and other financial institutions *en masse*. At that time, the institutional system responsible for financial stability was not yet in place (the Federal Reserve System, i.e. the central bank of the United States, was established as a response to the crisis), and thus the banker J.P. Morgan and his circle strived to stop the crisis. Within the framework of the rescue operation,

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Hubert János Kiss is a senior researcher at the Institute of Economics of the Research Centre for Economic and Regional Studies of the Hungarian Academy of Sciences and an assistant professor of the Department of Economics of the Faculty of Social Sciences of the Eötvös Loránd University.
E-mail: kiss.hubert.janos@krtk.mta.hu

This study was prepared with the support of the Bolyai János Research Scholarship.

The Hungarian manuscript was received on 6 September 2018.

DOI: http://doi.org/10.25201/FER.17.4.95111

Morgan told journalists that 'If the people would only leave their money in the banks ...everything would work out all right.'[1] In the meantime, his men visited all the priests, clergymen and rabbis of the city, and asked them to convince their followers not to withdraw their money from banks.[2] The rescue operation was successful, as the crisis subsided in a couple of weeks and life returned to normal. This is a story with a moral, as it was understandable amid the economic turmoil that depositors were worried about their savings and many started to withdraw their money from banks because of the uncertainty. Seeing this, others did the same, causing a bank panic. The opinion of credible people was needed to reverse this process and restore confidence in financial institutions. In 1933, an attempt was made to institutionalise confidence by establishing the Federal Deposit Insurance Corporation, and since 1934 a fund insures the deposits placed in banks up to a certain limit.

Following that, national deposit insurance systems were set up along similar principles in several countries. These systems basically worked well, as there were no bank runs in the developed countries for decades. However, the economic crisis known as the Great Recession started with the run on Northern Rock bank in Great Britain in the autumn of 2007. The withdrawal of deposits was surprising because the last bank run had taken place in 1866, the deposits were (partially) insured, and the Bank of England – the central bank of the United Kingdom – also declared that it would provide the necessary support to the bank to continue its operation (*Shin 2009*). The massive deposit withdrawals observed in the case of Northern Rock then recurred in other developed countries as well: for example, there were runs by depositors on Hong-Kong's Bank of East Asia, the Dutch DSB Bank and the US Indymac Bank, in spite of the fact that deposits were insured in these countries as well. These developments call attention to the fact that understanding depositors' decisions is still a question of current concern.

On the basis of the literature, this study attempts to summarise what is known about depositors' decisions. This issue is not a simple one. The mere fact that a depositor withdraws his money from a bank does not reveal much about the reason for his action. Did he need his money? Did he see others doing so and follow them? Or perhaps he learnt something bad about the bank? Two types of data sources may help to provide a more precise answer to the question of who withdraws money and why. Firstly, individual-level data may provide a comprehensive picture of the depositor, also including what information he had. Thus, it is easier to understand why he made the decision. As we will see, such detailed individual data are only rarely available. Secondly, with the help of experimental economics, depositors' decisions can be examined in a controlled environment, which facilitates the

[1] J. P. Morgan in 'Bankers Calm; Sky Clearing.' New York Times, 26 October 1907.
[2] The book by *Bruner and Carr* (*2008*) provides an excellent description of the crisis.

understanding of the driving forces behind them. Of course, the question may arise as to how relevant decisions taken in a computerised laboratory are in the real world. Accordingly, empirical results and results of experiments may jointly draw an overall picture that may contribute to a better understanding of depositors' behaviour.

In the next part, the main findings of empirical analyses are presented by answering some basic questions, followed by drawing conclusions from the experiments.

2. Empirical experiences

The main question concerning depositors' behaviour is whether they make a run on the bank(s), i.e. whether they withdraw their money *en masse*, in spite of the fact that at that particular moment they do not need liquidity. The most common underlying reason for such a mass withdrawal of deposits is that depositors do not believe that their money is at the right place in banks. It is important to note that it is an absolutely rational decision of a depositor to withdraw his money if he knows that the bank is not functioning well. If a bank run is observed in such a case, it can be considered efficient and a manifestation of market discipline.

2.1. Bank runs and fundamental problems, i.e. do depositors run on bad banks only?

First, let us examine the basic question of what kinds of banks depositors run on. If they run only on banks that fundamentally do not work well, they discipline financial intermediaries, and the regulatory authority does not have to interfere. However, if well-functioning banks also fall victim, regulation may be justified, as unwarranted interruption of financial intermediation may entail high macroeconomic costs (*Caprio – Klingebiel 1996; Valencia – Laeven 2012*). It is not easy to clearly tell whether there is a fundamental reason behind the mass deposit withdrawals or only unwarranted panic. *Chari and Jagannathan* (*1988*), for example, set up an interesting theoretical model to present this difficulty. They assume, *inter alia*, that depositors do not know how many people will need money in the coming period, and also that a group of depositors, the well-informed, know whether the bank is operating well or not. If in the next period a not well-informed depositor sees that many people are queuing up outside the bank, he will not be able to discern whether it is because many people were exposed to a liquidity shock and this is the reason why they are withdrawing their money, or whether well-informed depositors have heard some bad news about the bank, and there is a bank run. It is not worth running in the first case, but it is worth running in the second case. Deposit insurance was introduced because there was too much unwarranted panic, and deposit insurance created a safe asset that calmed depositors (*Gorton 2017*).

Many researchers are of the opinion that behind bank runs there are fundamental reasons, reasons of macroeconomic origin and/or ones that concern the bank. *Gorton* (*1988*) examines the example of the United States between 1863 and 1914 with the help of empirical data, and finds that each bank panic was preceded by significant deterioration in a key economic indicator. Accordingly, bank panics are systematically related to business cycles, and they are not mysterious events during which depositors start to withdraw their money from banks for inexplicable reasons.[3] The explanation for the latter was drawn up by *Diamond – Dybvig* (*1983*) in their influential study. In this, depositors decide whether to withdraw their money from a bank that is known to work well. They do not know one another's decisions, and thus their belief about others' decisions determines whether it is worth withdrawing the money. If a depositor thinks that the others will also withdraw their money and there will be a bank run, the best he can also do is to run to the bank. Accordingly, the bank run becomes a self-fulfilling prophecy. This is the bank run equilibrium. However, if the depositor thinks that there will be no bank run, it is worth leaving the savings in the bank. Then, a good equilibrium will materialise and there will be no bank run. In this model, depositors' behaviour may be influenced by anything, including things that are not related to the economy or the operation of the bank at all. The authors mention sunspots as an example. It is to be noted that it is possible to set up a model (e.g. *Goldstein – Pauzner 2005*) where the equilibria are not as undefined as in the Diamond–Dybvig model, but bank fundamentals determine which of the two equilibria will materialise. Following a similar train of thought, according to *Ennis* (*2003*) it is also possible that the economic situation determines the mood of depositors, who will be more inclined to have a negative opinion of the others' decision when hearing bad news, which may result in a bank run.

Not only *Gorton* (*1988*), but other authors also found strong correlation between macroeconomic/bank fundamentals and the probability of bank runs.[4] *Calomiris – Mason* (*2003*) find that between 1930 and 1933 the fundamentals (e.g. the assets and liabilities of the bank as well as the macroeconomic indicators of the given state) explain well which banks were run on in the United States. However, they also add that at the end of the period the number of bank runs increases, which cannot be captured with these variables. Examining US banks in the 1920s, *Davison – Ramirez* (*2014*) also come to similar conclusions: weaker economic fundamentals increase the chance of bank runs. They also examine what proportion of the banks that were run on is reopened, which suggests that banks basically functioned well and that depositors' panic was behind the withdrawals of deposits. They find that there is such panic in 40 per cent of the cases. They also emphasise that many

[3] *Allen – Gale* (*1998*) *and Jacklin – Bhattacharya* (*1988*) showed that fundamental bank runs can be captured with theoretical models as well.

[4] *Ennis* (*2003*), however, observes that in the period under review there were times when there were no bank runs in spite of bad economic fundamentals, and it also happened that mass deposit withdrawals took place while economic fundamentals were good.

panic-like runs may be attributable to asymmetrical information, i.e. depositors were unable to decide which banks actually had fundamental problems, and they ran not only on bad banks in the given region, but on good ones as well.

The aforementioned studies rely on older data, but studies using newer data also come to similar conclusions. *Schumacher* (*2000*), for example, analysing the effects of the 1994 tequila crisis that reached Argentina, notes that the chance of bank runs was higher in the case of banks with weaker fundamentals. Using Russian data between 2002 and 2007, the article by *De Graeve – Karas* (*2014*) examines to what extent the fundamentals and depositors' panic-like behaviour contributed to mass deposit withdrawals. They find arguments for both explanations. They observed higher deposit withdrawals in the case of worse banks than in the case of good ones, but the latter also often suffered from mass deposit withdrawals. On the whole, the authors find that the impact of panic-like behaviour is greater than that of decisions explained by fundamentals.

The effect of the assistance provided by the state is also worth mentioning. *Shin* (*2009*) presents that in the case of Northern Rock the depositors' run was triggered by the fact that the Bank of England provided liquidity assistance to the bank, and depositors considered this as a stigma, which shook confidence in the bank (*Hauser 2014*). With the help of a theoretical model, *Wang* (*2013*) came to the plausible conclusion that the existence of state assistance hampers the development of bank runs, because it calms depositors. However, as soon as it is announced that the given bank receives state assistance, it reveals that the government is aware of bad fundamentals, which may launch a run on the given bank. Examining the effects of the introduction of the Troubled Asset Relief Program (TARP), i.e. the US government's programme that helped banks, the author finds convincing empirical evidence to verify the above theory. During the examination of two Swiss banks, *Guin et al.* (*2015*) also find that in the case of the bank that had recourse to state assistance the magnitude of deposit withdrawal was significantly greater.

The message outlined on the basis of the above examples is that the chance of a run by depositors on worse banks is greater, but well-functioning banks may also face mass deposit withdrawals.

2.2. What happens in a bank run? Who runs and why?

The next question we seek an answer to is what happens during a bank run. What do we know about the depositors who run on the bank? Do they have easy-to-specify characteristic features? Do we know anything about their motives?

As mentioned above, there are not many bank runs for which detailed individual-level data are available. Various studies (*Kelly – Ó Gráda 2000, Ó Gráda – White 2003*) deal with the Emigrant Industrial Savings Bank (EISB), New York, which was

run on by depositors in 1854 and 1857 as well. The main reason for the first run was that news spread about another bank that it had long-term solvency problems, and although other banks did not have bad fundamentals, they were still run on, i.e. contagion took place. This bank run, which is independent of fundamentals, and in which the coordination of depositors leads to a bad equilibrium, corresponds to the assumptions of the Diamond–Dybvig model. As there was no fundamental problem with the bank, and it was able to pay, the run faded away. Mainly less wealthy depositors with shorter bank experience who did not have information on the fundamentals of the bank participated in this run. Typically, they were depositors with low levels of education. Much fewer educated, well-to-do clients with longer bank experience participated in this run. In the second case, in 1857, the bank run was the result of a shock that affected the financial system as a whole, and in the case of the EISB, wealthier, more experienced and more educated depositors who worked in skilled jobs started to withdraw their deposits. These depositors saw that the value of banks' investments was declining in general. It is not clear what depositors could know about developments in EISB's portfolio, but it is a fact that the portfolio also lost some of its value. Then the decisions of these depositors were followed by other depositors as well. This means that in this case the panic was attributable to asymmetrical information. As the whole banking sector was affected by the panic, total collapse could only be prevented by the suspension of convertibility. According to the data, depositors' gender or the number of their children did not affect their behaviour during any of the panics. Interestingly, New York papers wrote unfavourably of the depositors who withdraw their money in 1854 from the fundamentally well-functioning banks, calling the run senseless and needless. At the time of the 1857 mass deposit withdrawal, similarly to the later crisis described in the introduction, Catholic priests calmed people and assured followers that they do not withdraw their money from the bank either.

An interesting study in connection with wealth and the size of deposit is the one by *Starr – Yilmaz* (*2007*), which analyses a bank run that took place in Turkey in 2001, when depositors ran on an Islamic bank that was not covered by deposit insurance. The trigger was the closure of another large Islamic bank. According to the authors, in the case of the bank they examined there were no signs of fundamental problems. The bank in question was able to meet its payment obligations, and the run was over in about two months, as then already net deposit inflows were observed. The authors analyse the deposit withdrawal in the light of the sizes of deposits. This is essential because while the majority (90 per cent) of deposit withdrawals were small and carried out by small depositors, large depositors were responsible for 2 per cent of all deposit withdrawals, but in terms of the withdrawn amount they accounted for 62 per cent. The authors find that small depositors reacted to other small and medium depositors in a sensitive manner. Namely, if they saw long queues outside the bank, they tended to join. However, no similar reaction to

large depositors' deposit withdrawals was experienced. According to the authors' explanation, they probably could not be observed. The findings are similar in the case of medium depositors, i.e. they also strongly reacted when many small and medium depositors withdrew their money, but they did not panic when large depositors did so. Nevertheless, large depositors did not react to small depositors' mass deposit withdrawals at all, and reacted only moderately to the decisions of medium depositors, but immediate and significant deposit withdrawals by them were observed when large depositors withdrew their money. It is difficult to establish the effect of exactly what other characteristics is represented by the size of the deposit; the authors themselves also made a guess only. However, it seems rather convincing that the heterogeneity according to the size of the deposit (and the related characteristics) entails differences in behaviour.

Iyer et al. (*Iyer – Puri 2012, Iyer et al. 2016*) scrutinised Indian cooperative banks in several articles. The bank discussed in the first study suffered a run in 2001, after another cooperative bank in the same town had failed. The bank did not have any relations with the one that went bankrupt and also functioned well fundamentally, so in this case as well contagion was in the background. The bank was able to pay to its clients who withdrew their deposits, who calmed down after some time, and the bank run stopped. The authors find that the depositors whose savings exceeded the insured indemnity limit were more inclined to withdraw their money. However, the deposit insurance provided only partial protection against the panic, as the examination of fully insured deposits shows that in the case of larger deposits the chance of withdrawal was higher. All of this can be explained by the fact that in spite of the deposit insurance there are transaction costs for the depositor to access his money, and he might consider them too high. Another important finding is that the duration and depth of the relationship between the depositor and the bank mattered, which was in line with what is called bank experience on the basis of K*elly – Ó Gráda* (*2000*). The longer time a depositor had an account with the bank, the less likely it was that he would panic. If one also borrowed from the bank, it further reduced the probability of deposit withdrawal. There is a correlation between deposit insurance and credit as well. Namely, those who had savings exceeding the insured amount but did not borrow from the bank withdrew their money, while large depositors with a loan did not withdraw it. Longer and deeper experience may contribute to a depositor's having more information on the bank, so he will not run on it without a reason, and it also strengthens confidence. The authors also present the role of social networks. Firstly, they examine where the depositor lives, and how other depositors in his neighbourhood behave. They also study the introducer network, as somebody who already had an account had to recommend the given person to enable him to open an account. The role of these social networks is significant because they are important channels of the information that reaches the depositor. The authors observe that these networks capture not only the

common social and economic characteristics of their participants. Excluding these effects, it is seen that social networks were very important. The higher the ratio of acquaintances in the social network who acted similarly, the higher the chance that depositors withdrew their money. The authors also claim that social networks like this could even double the probability of a depositor withdrawing his money from the bank. Interestingly, the authors find that in the case of this bank run, educational level, age, wealth and stock ownership (which is a possible measure of financial sophistication) did not influence who withdrew their money or who did not. It is also interesting that the authors, using a questionnaire, specifically asked what determined the depositors' decision, and almost everybody mentioned confidence in the bank as an influencing factor.[5]

Another bank was run on by depositors in 2009, but that bank had fundamental problems. Due to its bad loans, the value of the bank was negative according to the central bank's analysis, and this bad news was revealed. The central bank partially suspended payments. More specifically, time deposits could not be withdrawn before maturity, but initially the money on the account was not subject to this limitation. The authors found that after the negative information became known, depositors reacted very differently, depending on their characteristic features. Compared to those who did not withdraw their money, the ones who withdrew their money after hearing the news typically had more money on their respective current accounts (and thus at the same time it was also more likely that their savings exceeded the amount covered by the deposit insurance), were more active bank clients in the year preceding the run, became clients of the bank about one year later on average and that it was more likely that they had a loan or were the employees of the bank. In terms of individual characteristics it was found that older depositors, ones with higher level of education or working in more skilled jobs preferred to withdraw their money. The impact of reading newspapers and financial literacy was also significant: depositors who were active in collecting information and who processed it better were more prone to withdraw their money. It is also an important question who withdrew their money prior to the central bank's announcement. The authors find that the longer someone had an account with the bank, the lower the probability of his withdrawing his money (before the announcement) was. However, a bank loan or being an employee of the bank increased the chance of deposit withdrawal. The social network effects presented above were also observed. Namely, if in someone's social network somebody withdrew his money, it considerably increased the probability that the given person would also do so. Interestingly, this bank suffered a bank run in 2001 as well, but then there were no fundamental problems. Comparing the two runs it is seen that the age of the bank account and the impact of the bank activity measured with

[5] The studies by *Osili – Paulson* (*2014*) and *Knell – Stix* (*2015*) also corroborate the not-surprising assertion that confidence in banks is a determinant of depositors' decisions.

the number of transactions (those with younger accounts and the more active depositors were more inclined to panic) are similar in the case of fundamental troubles and in their absence as well. However, if a depositor had a loan or was the bank's employee, the behaviour was different: they tended to run on the bank in the case of fundamental problems, while if there were no fundamental problems, they were less inclined to withdraw their money than other depositors. The probability of panic of those who had uninsured deposits was higher in both cases compared to insured depositors, but the likelihood of panic was much higher when there was a fundamental trouble than in the opposite case. These differences indicate that depositors react to the information related to the basic operation of the bank, and thus their behaviour is different if there are fundamental problems with the bank. However, the lack of difference in behaviour (in the case of the age of the bank account and the bank activity) shows that the explanation is not simple, as these indicators may also have a correlation with the depositor's knowledge, but they do not result in different decisions depending on the fundamentals. The findings also point out that older and insured deposits were the ones that proved to be really stable in the case under review.

In connection with the previous studies, examining two large Swiss banks, *Guin et al.* (*2015*) find that a strong bank–depositor relationship reduced the probability of deposit withdrawal. They also present that an increase in the cost of changing banks has a similar effect. Contrary to what was seen before, the findings were not affected by wealth, financial sophistication or interest in the financial crisis.

Finally, the effect of the social network is also discussed in brief. *Kelly – Ó Gráda* (*2000*) attach great importance to the role of the social network, which had an impact on the behaviour of depositors in the evolution of the bank runs on the Emigrant Industrial Savings Bank in 1854 and 1857, as many of the bank's depositors were immigrants from Ireland, who were bound together by their origin and the neighbourhood they lived in New York. In line with the above, *Iyer – Puri* (*2012*) and *Iyer et al.* (*2016*) also attach great importance to the role of social networks.

In relation to social networks, *Atmaca et al.* (*2017*) study a very similar phenomenon, but not deposit withdrawals. They examine whether one leaves the bank for good and whether one terminates his accounts. They have data on more than 300,000 depositors between 2005 and 2012, who were clients of a Belgian bank. With the help of the data they can quite precisely identify close or more distant family relations as well as neighbourhood relations. Unfortunately, they could not map other social network effects (e.g. friends, colleagues). It is also interesting about the data that in 2008 there was also a run on the bank by clients, and thus the effects of the (partial) social network can be examined prior to, during and after the crisis. The main finding is that when there was no crisis, only the decisions of close family members (spouse, parents, children, brothers and sisters) influenced the depositors:

if these close relatives left the bank, there was an increased chance that the given depositor would also do so. In a time of crisis, however, the decisions of more distant family members (e.g. the spouse's parents, uncle, aunt, cousin) also became important, and according to the analysis they were also taken into account by the depositors, and the impact of the decisions of closer family members was greater than before or after the crisis. All of this indicates that the role of information grows in a crisis situation, and then we strive to obtain relevant information from a wider circle. However, the impact of neighbours did not prove to be significant in this case either. This study also finds that the longer and deeper a client's relationship with the bank is, the less probable it is that he will leave the bank, and deposit insurance also has the expected effect, as the owners of fully insured deposits were much less likely to leave the bank than depositors whose savings were not completely protected.

What message takes shape on the basis of the above studies? The most basic one is perhaps that depositors did not behave the same way in the bank run, and their decisions were determined by their personal characteristics as well as bank/economic fundamentals. The effect of bank experience and relationship clearly influences depositors' decisions, but this effect also depends on whether the bank is struggling with fundamental problems. In absence of the latter, the above characteristics reduce the chance of deposit withdrawals, while in the case of fundamental problems they increase it. If there are no fundamental problems, less wealthy depositors with a low level of education tend to run, otherwise the wealthier depositors, ones with higher levels of education and better financial knowledge do so. This may be correlated with the fact that it is easier to imagine of the latter group that it is able to obtain and process relevant information about the fundamentals of the bank, so they only withdraw their money if it is fundamentally justified. The importance of the relationship between information and the fundamentals is shown by the fact that bank employees in the Indian case withdrew their money only when there was a fundamental problem. Information transmitted by the social network seems to be important, but we could see that the effects of the pieces of information from various networks are different, and the existence/lack of fundamental problems also affects the intensity of these effect. In line with expectations, deposit insurance has a bank run reducing effect, although it is important to see that the existence of deposit insurance alone is not sufficient to prevent mass deposit withdrawals. Obviously, it is not easy to draw the profile of depositors who run on the bank, and further research is needed for a better understanding of what factors and depositor's characteristics may lead to bank runs.

3. Experiments

Now let us talk about laboratory experiments. How to imagine an experiment like this? The participants of the experiment are sitting in a computer room, and using the information displayed on the screen (e.g. what decisions are taken by the others, how much money the participants will have depending on the decisions, etc.) they decide whether they will withdraw their money from the virtual bank or not. The experiment is meant to depict real life situations, so it is worth leaving the money in the bank if a sufficient number of depositors decide so, otherwise the early withdrawal (which leads to a bank panic) is the better solution. Experiments allow the examination of the effectiveness of regulatory instruments (suspension of convertibility and deposit insurance) as well. In the experiments, similarly to real life, there are depositors who need the money, so they withdraw it, and there are ones who do not have any prompt liquidity needs like that.[6] The presence of these two types is interesting because if someone sees that the depositor who made a decision prior to him withdrew his money, the former cannot know whether the latter did so because he needed the money or there is panic, and even those withdraw their money who do not need it. It is important to note that in economic experiments the participants' decisions are incentivized, i.e. at the end of the experiment they receive money depending on their own and the other participants' decisions.

As far as the depositors' personal characteristics are concerned, contrary to empirical analyses, the client–depositor relationship and the effect of bank experience cannot be analysed in laboratory experiments, because the time of the experiment (typically 1–2 hours) is not suitable for the evolution of such relations and experience. Nevertheless, it is possible to measure the impact of previous negative experiences, e.g. a survived financial crisis. Based on empirical data, *Osili – Paulson* (*2014*) find that if someone suffered the negative experiences of a financial crisis, he is less willing to put his money in the bank. It was found in experiments in several cases (*Garratt – Keister 2009; Kiss et al. 2014a*) that those who in previous rounds had been depositors of a bank where there was a bank run later were more inclined to withdraw their money. *Kiss et al.* (*2016 and 2014b*) also establish that cognitive abilities have an impact on depositors' decisions; more clever depositors make better decisions (when it can be clearly determined which decision is better), and they do not find any differences in terms of gender, i.e. women do not panic more than men. This is in line with the empirical results presented above. *Dijk* (*2017*) showed that fear induced in subjects led to more bank panic, which suggests that the impact of the wider environment on our feelings may also be important. The author finds that women are more inclined to withdraw their money from the bank as a result of incited fear.

[6] As the depositors of the first type will withdraw their money in any case, they do not make definitive decisions. Therefore, these depositors' decisions are usually simulated by a computer in the experiments.

The effect of the information available on other depositors' decisions was also researched in a number of experiments, corresponding to the findings of the investigations related to social networks. When there is no fundamental problem with the bank, the observation of other depositors' decisions has a considerable effect, and the effect depends on what we see. In accordance with the theoretical results (*Kinateder – Kiss 2014*), *Kiss et al.* (*2014a*) find that if the observed decisions show that others do not withdraw their money, this is reassuring compared to the situation when we do not know anything about how others decided. However, if the observations show that others withdrew their money, it increases the probability of deposit withdrawal compared to when we do not have information about others' decisions. *Kiss et al.* (*2018*) also point out that the panic-like deposit withdrawal following the observation of the deposit withdrawal is attributable to the fact that subjects consider it too likely that depositors who do not need their money were the ones who withdrew it. In other words, if they see that others withdraw their deposits, in the majority of cases they will think that there is a bank run, even if this is not the case. When the empirical results were discussed we could see that there may be contagion as well among banks, i.e. if a depositor sees that other banks are run on, he will also withdraw his money, even if there is no fundamental problem with his bank. *Chakravarty et al.* (*2014*) also demonstrated this in an experiment, while *Brown et al.* (*2016*) supplement this result with the finding that after the run on the other bank the depositor believes that there is an increased probability that his own bank's other depositors will withdraw their money, and this is why it is more likely that he will withdraw his own deposit.

Schotter – Yorulmazer (*2009*) also change the state of the economy during the experiment, and in line with the expectations they find that deposit withdrawal is faster if economic fundamentals are worse. They also examined the impact of deposit insurance, and in line with the empirical results they find that the existence of deposit insurance reduces the development of bank runs, although it does not preclude them completely. The findings of *Madies* (*2006*) and *Kiss et al.* (*2012*) were similar. *Davis – Reilly* (*2016*) present that the impact of the suspension of convertibility on the development of bank runs depends on how tough the bank is, i.e. how much money the depositors can withdraw if deposit withdrawal is limited due to a bank panic. When the banks were tough, fewer bank runs arose.[7] Interestingly, the observation of other depositors' decisions impaired this effect, but when the bank was lenient, the observability of other depositors' decisions reduced the development of a bank panic.

As shown, the results of experiments are mostly in line with the ones seen in empirical studies. Many of the listed results were observed in various experiments,

[7] *Ennis – Keister* (*2009*) present that it is not always simple to announce a tough suspension of convertibility system in the case of a bank panic and then to comply with it if a bank run really takes place.

on several occasions and with different participants, and thus we can be quite sure of the validity of these findings. Let us notice that in the case of the empirical results we cannot know for sure how environment-specific the observed decision is and to what extent it can be generalised. Experiments help the research in this field, as replicability is a fundamental requirement concerning experiments.

4. Conclusions

One of the main and at the same time most spectacular phenomena of economic and financial crises is the bank run, during which masses of depositors withdraw their money from the bank(s) in spite of the fact that at the given moment they do not need their savings. These bank runs may be efficient and may discipline credit institutions if the banks that suffer them really have functional problems. This study demonstrated that depositors run not only on bad banks, and it is desirable to avoid these unwarranted bank runs. However, this requires a better understanding of depositors' behaviour, for which empirical studies and experiments may provide help. Unfortunately, there are only a few empirical studies that examine depositors' decisions on the basis of individual-level data. Moreover, several of them examine bank runs that took place a long time ago, and some of the more recent ones can be considered special (to what extent can the behaviour observed in Indian cooperative banks be generalised and applied to the depositors of developed economies?). The controlled environment of the experiments helps to identify the mechanisms that are outlined on the basis of the empirical studies and descriptions, and as the experiments can be conducted at any time and at any place, after a sufficient number of examinations one can be sure that generalisation is possible.

The available empirical and experimental data draw the following picture: depositors are heterogeneous along various dimensions, and this heterogeneity has an impact on depositors' decisions. In connection with the characteristics it is worth examining the characteristics in relation to which we may think that the depositor obtains information on bank fundamentals and makes his decision based on that. It seems that education, financial sophistication, wealth as well as experience and relationship with the given bank are characteristics of this kind, i.e. if there are no fundamental problems, they reduce the probability of deposit withdrawal, while if fundamental problems exist, these characteristics add to the likelihood of withdrawals. There is also evidence from experiments that better cognitive abilities lead to better decisions. Confidence in banks reduces mass deposit withdrawals, whereas fear (especially in the case of women) increases them, which suggests that regulatory institutions and ones responsible for financial stability significantly affect depositors' expectations. In relation to that, we also saw that deposit insurance

and suspension of convertibility are effective in the sense that both empirically and in the experiments they reduce the probability of a bank run, although they are unable to preclude it completely, even if it is clear that the bank does not have any fundamental problems (as in the experiments where payoffs were certain) or if the central bank is sure to save the bank (see the case of Northern Rock). Based on empirical observations and experiments, the role of social networks and the observation of the decisions of other depositors are also important factors, as the more deposit withdrawals a depositor sees, the more inclined he will be to withdraw his money.

The above findings suggest that we have rather precise knowledge of depositors' behaviour, although our knowledge is not complete at all, and answers also change as the world changes. We do not know exactly, for example, how social media affects depositors. In the case of several bank panics, information or rumours spreading with the help of social media have been mentioned as causes in recent years.[8] The Bank of England set up a system that strives to forecast bank runs with the help of Twitter messages.[9] The institutional environment is also changing: in Europe, for example, the banking union may bring a radical change. Depositors also change; generations X, Y and Z are provably different from previous generations, which may be reflected in their depositor decisions as well. We cannot lean back; we must continue our research of depositors' behaviour in this changing environment.

References

Allen, F. – Gale, D. (1998): *Optimal financial crises*. Journal of Finance, 53(4): 1245–1284. https://doi.org/10.1111/0022-1082.00052

Atmaca, S. – Schoors, K. – Verschelde, M. (2017): *Bank Loyalty, Social Networks and Crisis*. Journal of Banking & Finance, under publication. https://doi.org/10.1016/j.jbankfin.2017.12.007

Brown, M. – Trautmann, S.T. – Vlahu, R. (2016): *Understanding bank-run contagion*. Management Science, 63(7): 2272-2282. https://doi.org/10.1287/mnsc.2015.2416

Bruner, R. F. – Carr, S.D. (2008): *The Panic of 1907: Lessons Learned from the Market's Perfect Storm*. John Wiley & Sons.

[8] For example, social media was mentioned as the main trigger of the bank panic in the case of the Kazakh Kaspi Bank and Centercredit Bank, the Alliance Bank, the Bulgarian Corporate Commercial Bank (KTB) and First Investment Bank (FIB or Fibank) in 2014, and in the case of the Kenyan Chase Bank in 2016.

[9] https://bankunderground.co.uk/2015/08/18/tweets-runs-and-the-minnesota-vikings. Downloaded: 5 September 2018.

Calomiris, C. – Mason, J.R. (2003): *Fundamentals, Panics, and Bank Distress During the Depression*. American Economic Review, 93(5): 1615–1647. https://doi.org/10.1257/000282803322655473

Caprio, G. – Klingebiel, D. (1996): *Bank insolvencies cross-country experience*. World Bank Publications.

Chakravarty, S. – Fonseca, M.A. – Kaplan, T.R. (2014): *An experiment on the causes of bank run contagions*. European Economic Review, 72(November): 39–51. https://doi.org/10.1016/j.euroecorev.2014.09.003

Chari, V. V. – Jagannathan, R. (1988): *Banking panics, information, and rational expectations equilibrium*. The Journal of Finance, 43(3): 749–761. https://doi.org/10.1111/j.1540-6261.1988.tb04606.x

Davis, D. D. – Reilly, R.J. (2016): *On freezing depositor funds at financially distressed banks: An experimental analysis*. Journal of Money, Credit and Banking, 48(5): 989–1017. https://doi.org/10.1111/jmcb.12324

Davison, L. K. – Ramirez, C.D. (2014): *Local banking panics of the 1920s: Identification and determinants*. Journal of Monetary Economics, 66(September): 164–177. https://doi.org/10.1016/j.jmoneco.2014.05.001

De Graeve, F. – Karas, A. (2014): *Evaluating theories of bank runs with heterogeneity restrictions*. Journal of the European Economic Association, 12(4): 969–996. https://doi.org/10.1111/jeea.12080

Diamond, D. W. – Dybvig, P.H. (1983): *Bank runs, deposit insurance, and liquidity*. Journal of Political Economy, 91(3): 401–419. https://doi.org/10.1086/261155

Dijk, O. (2017): *Bank run psychology*. Journal of Economic Behavior & Organization, 144 (December): 87–96. https://doi.org/10.1016/j.jebo.2017.08.005

Ennis, H.M. (2003): *Economic Fundamentals and Bank Runs*. Federal Reserve Bank of Richmond Economic Quarterly, 89(2): 55–71.

Ennis, H.M. – Keister, T. (2009): *Bank runs and institutions: The perils of intervention.* American Economic Review, 99(4): 1588–1607. https://doi.org/10.1257/aer.99.4.1588

Garratt, R. – Keister, T. (2009): *Bank runs as coordination failures: An experimental study*. Journal of Economic Behavior & Organization, 71(2): 300–317. https://doi.org/10.1016/j.jebo.2009.03.009

Goldstein, I. – Pauzner, A. (2005): *Demand–deposit contracts and the probability of bank runs*. Journal of Finance, 60(3): 1293–1327. https://doi.org/10.1111/j.1540-6261.2005.00762.x

Gorton, G. (1988): *Banking panics and business cycles.* Oxford Economic Papers, 40(4): 751–781. https://doi.org/10.1093/oxfordjournals.oep.a041885

Gorton, G. (2017): *The history and economics of safe assets*. Annual Review of Economics, 9: 547–586. https://doi.org/10.1146/annurev-economics-033017-125810

Guin, B. – Brown, M. – Morkötter, S. (2015): *Deposit Withdrawals from Distressed Commercial Banks*. Manuscript.

Hauser, A. (2014): *Lender of last resort operations during the financial crisis: seven practical lessons from the United Kingdom*. BIS Papers, No 79, pp. 81–92.

Iyer, R. – Puri, M. (2012): *Understanding Bank Runs: The Importance of Depositor-Bank Relationships and Networks*. American Economic Review, 102(4): 1414–1445. https://doi.org/10.1257/aer.102.4.1414

Iyer, R. – Puri, M. – Ryan, N. (2016): *A tale of two runs: Depositor responses to bank solvency risk*. Journal of Finance, 71(6): 2687–2726. https://doi.org/10.1111/jofi.12424

Jacklin, C.J. – Bhattacharya, S. (1988): *Distinguishing panics and information-based bank runs: Welfare and policy implications.* Journal of Political Economy, 96(3): 568–592. https://doi.org/10.1086/261552

Kelly, M. – Ó Gráda, C. (2000): *Market Contagion: Evidence from the Panics of 1854 and 1857*. American Economic Review, 90(5): 1110–1124. https://doi.org/10.1257/aer.90.5.1110

Kinateder, M. – Kiss, H.J. (2014): *Sequential decisions in the Diamond–Dybvig banking model*. Journal of Financial Stability, 15(December): 149–160. https://doi.org/10.1016/j.jfs.2014.09.004

Kiss, H.J. – Rodriguez-Lara, I. – Rosa-García, A. (2012): *On the effects of deposit insurance and observability on bank runs: an experimental study*. Journal of Money, Credit and Banking, 44(8): 1651–1665. https://doi.org/10.1111/j.1538-4616.2012.00548.x

Kiss, H.J. – Rodriguez-Lara, I. – Rosa-García, A. (2014a): *Do social networks prevent or promote bank runs?* Journal of Economic Behavior & Organization, 101(May): 87–99. https://doi.org/10.1016/j.jebo.2014.01.019

Kiss, H.J. – Rodriguez-Lara, I. – Rosa-Garcia, A. (2014b): *Do women panic more than men? An experimental study of financial decisions*. Journal of Behavioral and Experimental Economics, 52(October): 40–51. https://doi.org/10.1016/j.socec.2014.06.003

Kiss, H. J. – Rodriguez-Lara, I. – Rosa-García, A. (2016): *Think twice before running! Bank runs and cognitive abilities*. Journal of Behavioral and Experimental Economics, 64(October): 12–19. https://doi.org/10.1016/j.socec.2015.01.006

Kiss, H.J. – Rodriguez-Lara, I. – Rosa-Garcia, A. (2018): *Panic bank runs*. Economics Letters, 162(January): 146–149. https://doi.org/10.1016/j.econlet.2017.11.014

Knell, M. – Stix, H. (2015): *Trust in banks during normal and crisis times—evidence from survey data*. Economica, 82(s1): 995–1020. https://doi.org/10.1111/ecca.12162

Madies, P. (2006): *An Experimental Exploration of Self-Fulfilling Banking Panics: Their Occurrence, Persistence, and Prevention*. Journal of Business, 79(4): 1831–1866. https://doi.org/10.1086/503650

Ó Gráda, C. – White, E. (2003): *The Panics of 1854 and 1857: A View from the Emigrants Industrial Savings Bank*. Journal of Economic History, 63(1): 213–240. https://doi.org/10.1017/S0022050703001785

Osili, U.O. – Paulson, A. (2014). *Crises and confidence: Systemic banking crises and depositor behavior.* Journal of Financial Economics, 111(3): 646–660. https://doi.org/10.1016/j.jfineco.2013.11.002

Schotter, A. – Yorulmazer, T. (2009): *On the dynamics and severity of bank runs: An experimental study*. Journal of Financial Intermediation, 18(2): 217–241. https://doi.org/10.1016/j.jfi.2008.06.002

Schumacher, L. (2000): *Bank runs and currency run in a system without a safety net: Argentina and the 'tequila' shock*. Journal of Monetary Economics, 46(1): 257–277. https://doi.org/10.1016/S0304-3932(00)00022-2

Shin, H.S. (2009): *Reflections on Northern Rock: The bank run that heralded the global financial crisis*. Journal of Economic Perspectives, 23(1): 101–119. https://doi.org/10.1257/jep.23.1.101

Starr, M.A. – Yilmaz, R. (2007): *Bank runs in emerging-market economies: evidence from Turkey's special finance houses*. Southern Economic Journal, 73(4): 1112–1132.

Valencia, F. – Laeven, L. (2012): *Systemic Banking Crises Database: An Update*. IMF Working Paper.

Wang, C. (2013): *Bailouts and bank runs: Theory and evidence from TARP*. European Economic Review, 64(November): 169–180. https://doi.org/10.1016/j.euroecorev.2013.08.005

Monitoring of Banks' Risks Related to the Funding of Financial Enterprises*

György Inzelt – Zsuzsa Szentes-Markhot – Gábor Budai

The crisis period which commenced in 2008 highlighted the fact both at domestic and international level that in certain cases financial enterprises – which operate in a more relaxed prudential regulatory framework compared to banks – accumulated substantial credit risks that generated major losses for the financing credit institutions. This paper presents a simple, straightforward tool for monitoring banks' risks related to the funding of financial enterprises operating in Hungary. This tool can be reproduced based on the balance sheet and income statement data of corporate databases, and at the same time its performance is stable and as such it can be widely utilised, it facilitates close, automated monitoring and can be used as a financial warning model, which permits the allocation of a relative risk level to financial enterprises either in the medium term or 2 years ahead. It can be concluded that, based on the foregoing, prior to the major world economic crisis that commenced in 2008, it would have been possible to identify risky financial enterprises and banks could have closed or amortised their exposures to risky financial enterprises earlier, as necessary. To our knowledge, at the time of the publication this type of risk measurement methodology is unprecedented in the Hungarian literature in respect of banks' risks in relation to lending to financial enterprises.

Journal of Economic Literature (JEL) codes: G23, C53

Keywords: non-bank financial institutions, forecast

1. Features and supervision of Hungarian financial enterprises

1.1. Hungarian regulation and supervision

In this paper, we examine financial enterprises – as specified in Section 9(1) of Act CCXXXVII of 2013 on Credit Institutions and Financial Enterprises (Credit Institution Act) – which are not owned by a banking group.

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

György Inzelt, Head of Division at the Magyar Nemzeti Bank, the developer of the methodology passed away before the finalisation of the paper.
Zsuzsa Szentes-Markhot is a Head of Division at the Magyar Nemzeti Bank. E-mail: markhotzs@mnb.hu
Gábor Budai is Senior Supervisor at the Magyar Nemzeti Bank. E-mail: budaig@mnb.hu

The Hungarian manuscript was received on 29 March 2018.

DOI: http://doi.org/10.25201/FER.17.4.112139

Based on the Credit Institution Act, financial enterprises may essentially perform similar activities as credit institutions – both types of institutions qualify as financial institutions (Section 7(1)) and according to the Credit Institution Act, financial services activity may be performed on a professional basis solely by financial institutions (Section 7(2)) – and thus their regulation is also similar in many respects. On the other hand, the most important difference between the two types of institutions is that financial enterprises may not collect deposits and render payment services, and thus any loss they may incur can only represent a risk for clients through the credit institutions which finance them. Consequently, the potential liquidation of a financial enterprise has a substantially smaller negative effect on the (household, corporate) clients using the financial services than in the case of a bank. In line with this, compared to credit institutions, financial enterprises may be established with much smaller initial capital (HUF 50 million), and furthermore, the capital requirements specified in the European Union's capital requirement regulation (CRR[1]) are also not applicable to them. Exceptions to the latter include financial enterprises owned by a credit institution, which are thus subject to consolidation.

The crisis which commenced in 2008 drew attention to the crucial importance of macroprudential regulation and to the fact that microprudential regulation can be circumvented in certain cases. One of the related risks, relevant for this paper, is the financing of financial enterprises, since in this way the financing credit institutions (seemingly) did not undertake the risk of clients which – according to their own lending policy – probably would not be eligible for financing. At the same time, during the years of the crisis – not only in Hungary – credit institutions suffered major losses on the financing of financial enterprises which did not manage client funds and were thus less strictly regulated.

With a view to addressing the problem, the European Banking Authority (*EBA 2016*)[2] regulated the measurement and reporting of the exposures of regulated credit institutions to not only financial institutions, but also to the shadow banking system, and formulated minimum requirements with regard to the related risk management processes. The Hungarian regulation adopted the EBA directive in the form of a recommendation, with effect from 1 January 2017 (*MNB 2016a*).

Both the EBA and the Magyar Nemzeti Bank's (MNB) shadow banking regulation, and particularly the part thereof related to financial enterprises, identify as a key risk

[1] *CRR (Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012): Article 395 (5)* In: Official Journal of the European Union, 27.6.2013. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0575&from=EN. Downloaded: 3 January 2017.

[2] EBA (2016): *Limits on exposures to shadow banking entities which carry out banking activities outside a regulated framework under Article 395(2) of Regulation (EU) No. 575/2013.* EBA/GL/2015/20 https://www.eba.europa.eu/documents/10180/1310259/EBA-GL-2015-20+GL+on+Shadow+Banking+Entities_EN.pdf. Downloaded: 3 January 2017.

that in the case of financial enterprises – partly due to the less strict regulation – the use of short-term funds and vulnerability arising from high leverage are typical; there also may be a partial overlap of ownership with the financing credit institutions, while crisis situations are characterised by the fast withdrawal of the provided funds and the closing of the credit lines. With a view to managing the aforementioned risks, the EBA directive and the MNB recommendation expect the institutions to take into consideration the assumed risks in the course of their Pillar 2 risk management processes and capital planning, and the management board of the supervised credit institutions should be aware of the assumed risks, and take responsibility for such by their approval (of the related risk appetite and limit breach). Finally, depending on the maturity of the internal risk measurement and management, the institution may either set limits on its own or it must comply, at all times, with the large exposure limits specified in the international regulation (*CRR 2013*).[3]

The EBA prepared a report (*EBA 2014*),[4] which provides information on the national regulatory frameworks related to institutions pursuing similar activity as banks, but falling outside the scope of the EU laws applicable to credit institutions. Based on that, it can be established that the licensing and oversight practices applicable to institutions pursuing similar activity as Hungarian financial enterprises vary to a great degree from country to country; the regulation largely depends on what the individual authorities regard as risky activity and what kinds of bad practices and processes they identified as a result of the crisis.

Based on the Hungarian laws, financial enterprises are supervised both in prudential and consumer protection terms. In view of the fact that, pursuant to the laws, financial enterprises may not collect customer deposits, in terms of their individual, institution-level supervision – primarily with the customers' interest in mind – the focus has shifted mainly to the forecast and management of consumer protection risks in the past period. In addition, prudential supervision of financial enterprises may be realised the most efficiently – in accordance with the foregoing – through the banks they are owned or financed by.

Although the weight of this sector in Hungarian credit institutions' exposures is not so great that we can talk about the build-up of a shadow banking system, as we mentioned before, in the years of the crisis banks realised significant losses as a result of the deterioration in the financial situation at the refinanced financial enterprises. Accordingly, the purpose of this paper is to call the attention of domestic credit institutions to the possibility of developing a rating system operating

[3] CRR 2013 In: Official Journal of the European Union, 27.6.2013. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0575&from=EN. Downloaded: 3 January 2017.
[4] EBA (2014): *Report to the European Commission on the perimeter of credit institutions established in the Member States*. http://www.eba.europa.eu/documents/10180/534414/2014+11+27+-+EBA+Report+-+Credit+institutions.pdf. Downloaded: 3 January 2017.

based on similar principles as the model presented here, which may foster the prudent financing of the financial enterprises sector. In line with this, the financial enterprises owned by banking groups registered in Hungary, fall outside the scope of this analysis in view of the fact that their financing and risk monitoring may be implemented in a different framework, and due to the reasons detailed in *Section 2.2.2,* negative events are less likely to arise in their case.

1.2. Characteristics of the financial enterprises sector

The most typical activities of financial enterprises operating in the Hungarian market include lending, financial leasing, factoring and distressed debt management, and the enterprises often mix these activities (*MNB 2016b, 2017, 2018*). Since the end of the 1990s, the sector has been characterised by rapid growth both in terms of the number of institutions and the aggregated balance sheet total, as a result of which, after 2005 the entirety of the sector reached the size of the middle-sized banks in Hungary in terms of its balance sheet total and outstanding receivables. However, as a result of deepening crisis in 2009 the earlier growth came to a halt (*Table 1*).

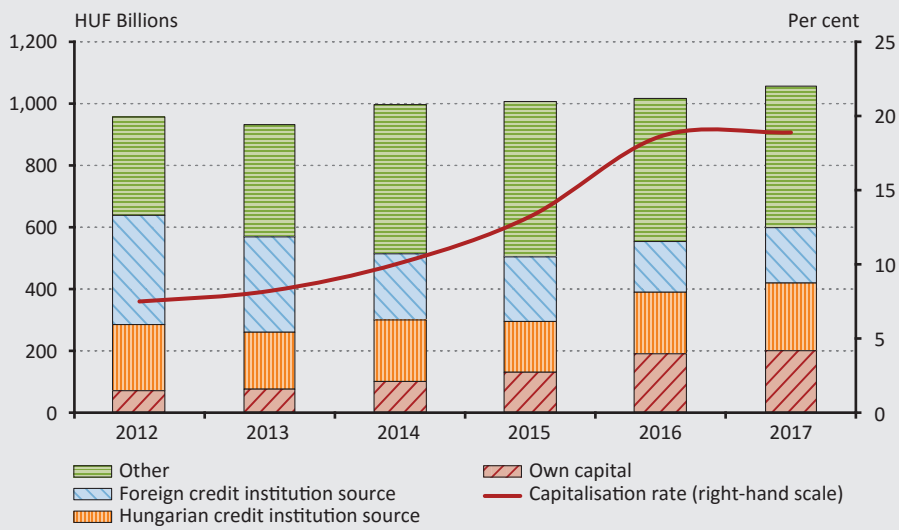
As regards the breakdown of gross outstanding receivables, the activity of financial enterprises is still dominated by lending, followed by leasing (*MNB 2018*). At the same time, it is a remarkable trend that, when examining the entire sector of financial enterprises not belonging to a banking group, both types of receivables declined and the portfolio of purchased non-performing receivables shows major growth since the crisis (*MNB 2016b, 2017, 2018*).

Due to the losses suffered by the financing institutions as a result of the crisis, the credit institution sector tends to be gradually withdrawing from the financing of financial enterprises, thereby making it more difficult for these institutions to raise funds. In parallel with this, within the scope of the portfolio cleansing process, credit institutions make efforts to sell their non-performing receivables, and thus the financial enterprises established in recent years usually submitted activity licence applications for the purchase of non-performing receivables (*MNB 2016b*), and the number of institutions pursuing solely this activity also rose (*MNB 2017, 2018*). It is partly attributable to the aforementioned developments and to EU transfers that the number of financial enterprises did not decrease dramatically even as a result of the crisis; the sector is rather characterised by stagnation and in the past few years – following consolidation in the sector – once again by moderate growth.

Examining the liability structure of financial enterprises not belonging to a banking group, it can be established that bank financing essentially followed the general lending trends, with substantially decreasing placement of funds during the crisis period, followed by an increase in the past year (*MNB 2016b, 2017, 2018*). It is also evident from *Figure 1* that in line with the general economic recovery, financing by credit institutions in Hungary already moved on an upward trend in the past

two years, which primarily affected financial enterprises pursuing workout activity (*MNB 2018*). In terms of magnitude, the loans placed with financial enterprises cannot be deemed high at the sector level, but in view of its increasing trend, the process deserves attention both in terms of business and risk. The changes in other liabilities show that in the post-crisis years financial enterprises were only partially able to compensate for the lost credit institution funding (mostly through financing by the owner). However, in the past two years the sector's balance sheet total was able to expand even in conjunction with a decrease in other liabilities. Although the equity balance rose since 2012, and in parallel with that the capitalisation level also improved, this was mostly attributable to the profitable operation of certain larger institutions (pursuing household lending and workout activity).

Figure 1
Developments in the liability structure of financial enterprises not belonging to a banking group



Source: MNB 2018

As regards the breakdown by size, the financial enterprise sector is very heterogeneous not only in terms of the activities pursued, but also in terms of the institutions' balance sheet total: the 10 largest institutions – not belonging to any banking or other institutional group – have a market share of roughly 50 per cent. The largest market participants are typically financial enterprises with well capitalised, non-resident owners, accompanied by several smaller institutions, usually owned by residents (*MNB 2017*). The structure of the market, including a few larger and several smaller institutions, is well illustrated by the fact that at the end of 2017, the 5 institutions realising the highest balance sheet profit

accounted for 80 per cent of the profit of the sector under review (*MNB 2018*). Due to the composition of the market and its negligible size compared to the overall Hungarian banking sector, one-off movements (e.g. the withdrawal of a larger institution from the market, the sale of a larger package of bank receivables, or of a financial enterprise which formerly belonged to a banking group) can generate major changes in the entire balance sheet total and often also in the financing extended by the banking groups.

It follows from the heterogeneity of the sector that risks also vary greatly, depending on the size and activity type of the institutions. At smaller financial enterprises, it can be observed that upon the exhaustion of owner financing or failure to attract financing institutions, they are often unable to reach the size of operation necessary for their profitable functioning and thus they opt to leave the market, or their activity licence is withdrawn, because they are unable to comply with the legislative requirements related to equity or other conditions applicable to prudent operation. Furthermore, after the financial crisis, we saw several examples when financial enterprises operating with high leverage and without adequate control by the financing institution did not pursue sufficiently prudent lending policy and were liquidated due to the losses incurred. It is difficult to compare the risks of financial enterprises purchasing non-performing receivables with institutions pursuing lending activity, as in their case profitability primarily depends on the proper assessment of the defaulted portfolios, the employment of properly skilled collection experts and the development of a cost-efficient operational model.

Based on the foregoing, it may be worth considering the development of different risk monitoring models for institutions with different risk features; however, we rejected this idea primarily due to the substantial decrease in the number of elements in the sample. At the same time, it should be noted that – despite the reliability of the model to be presented below – in view of the occasionally substantially different business model of the institutions, we deem the monitoring tool to be an efficient instrument for monitoring the refinancing risks primarily as a supplement to individual expert ratings.

1.3. Arguments for the risk monitoring of the segment

At present, due to its size and based on former experiences, the financial enterprises segment represents no systemic risk or at least not to the degree seen in some of the Western European economic regimes – the Netherlands can be mentioned as a European example (*Broos et al. 2012*). Nevertheless, as also mentioned in the introduction, in the past decade financial enterprises have gained increasing importance both in terms of their number and risk assumption. The risks built up earlier were highlighted in this sector primarily by the financial market crisis which commenced in 2008, as follows:

- referring back to the lending processes described in the previous subsection, medium-sized and large banks registered in Hungary often financed financial enterprises with inadequate risk management, pursuing household and corporate lending or factoring and suffered major losses on such transactions;
- in several sub-markets – e.g. in the household mortgage and lease credit markets – financial enterprises often appeared with inadequate skills and background, and insufficiently prepared business models and lending processes, thereby contributing to the spread of the bad lending practices observed before the crisis;
- finally, in connection with the previous point, bad practices – often also in terms of consumer protection – started to be spread by certain financial enterprises.

The risks outlined in the foregoing declined substantially in the past few years, partly due to the macroprudential regulation by the MNB, which prevented excessive household lending (i.e. payment-to-income ratio and the regulation limiting the loan-to-collateral ratio, which are also mandatory for the financial enterprises), and partly due to consolidation of the sector.

Nevertheless, it should be examined whether the risk monitoring tool calibrated during the crisis for financial enterprises not belonging to a banking group also performs properly under a clearer regulatory framework and stronger oversight. If so, it may serve as an additional tool for surveying and monitoring the risks, economic strength and viability of financial enterprises which may potentially be refinanced. Accordingly, in the following we present a simple, yet stable monitoring tool, which allocates non-banking group financial enterprises operating in Hungary to risk segments.

2. Monitoring model for Hungarian financial enterprises

2.1. Risk features of the segment

As presented in *Subsection 1.2*, the rapid spread of financial enterprises, as a financial institution segment, commenced at the end of the 1990s and peaked in the middle of the decade thereafter. During the subsequent crisis years, financial enterprises – similarly to the credit institutions active in Hungary – implemented major deleveraging, partly due to the compulsion arising from the contraction of funding from credit institutions.

In parallel with the strong growth in the receivables of financial enterprises, the risks of the segment also rose significantly (*Table 1*). It can be observed that the negative event ratio (i.e. liquidation, bankruptcy proceedings, removal by the court, completed liquidation, forced dissolution within one year after the balance sheet date of the respective annual report), increased substantially in parallel with growth in the segment's balance sheet total and receivables, due to the deterioration in the

quality of receivables after the deepening crisis in 2009. Then, after the consolidation of the economic policy in 2012 and the liquidation of financial enterprises with unsustainable business model, the risk of the entire sector gradually decreased.

Table 1
Overview of the segment of financial enterprises not belonging to a banking group and of their risk features

Year of the Tax Authority (NTCA) report	Number of financial enterprises (non-banking)	Negative events	Negative event ratio (1-year, per cent)	Balance sheet total (HUF billions)	Outstanding receivables (HUF billions)
1992	8	0	0.00%	3	1
1993	10	0	0.00%	21	2
1994	11	0	0.00%	28	3
1995	11	0	0.00%	36	5
1996	15	0	0.00%	52	24
1997	38	0	0.00%	70	35
1998	49	0	0.00%	107	68
1999	83	0	0.00%	122	88
2000	106	0	0.00%	142	112
2001	118	0	0.00%	177	137
2002	123	0	0.00%	224	165
2003	135	0	0.00%	325	250
2004	157	2	1.27%	464	325
2005	166	1	0.60%	562	459
2006	184	1	0.54%	724	545
2007	201	4	1.99%	940	730
2008	211	1	0.47%	1,273	980
2009	213	1	0.47%	1,146	850
2010	212	4	1.89%	1,302	1,006
2011	212	6	2.83%	1,224	938
2012	213	4	1.88%	1,225	774
2013	220	4	1.82%	1,146	717
2014	223	2	0.90%	1,192	881
2015	215	0	0.00%	1,339	816
2016	220	1	0.45%	1,370	788

Note: Brown shading denotes the development sample (NTCA reporting years of 2004-2011), while light blue denotes the validation sample (NTCA reporting years for 2002–2014). Finally, green denotes the time-barred test sample (NTCA reporting year 2016).

Source: Calculated based on the databases of the National Tax and Customs Administration (NTCA) and Opten

As presented in the previous subsections of this paper, according to our expectations, due to the regulatory and operating environment, it is not primarily the capital, but rather the liquidity, refinancing and rollover risks that strongly explain the operating difficulties of financial enterprises. An additional risk, following from the regulation, is the risk of business models with a limited possibility of diversification, since the ban on managing client funds permits the transformation of the structure of funding resources to a limited degree. Finally, financial enterprises are marginal, "niche" players in almost all modern financial systems, i.e. they have to run major credit risk due to the fact that, apart from a few exceptions, they are compelled to finance clients rejected by the larger actors. Later on, we present in detail how and to what extent these economic expectations were confirmed by the primarily data-driven development.

2.2. Applied segmentation and modelling practice

2.2.1. Overview of the literature

The supervised institutions and the international credit rating agencies usually assess the refinancing and credit risks of financial enterprises by closely followed rating systems developed on a shared sample of banks, insurers and perhaps of investment funds. The inevitable result of this practice is that finally the model is calibrated separately for the individual sub-segments or, simplifying it, aiming at the most general approach possible, it is developed on the basis of a few key balance sheet and income statement variables. These modelling approaches include the Moody's model (*Hill – Auquier 2014*), where in addition to the macroeconomic variables, the independent variables include, among other things, the return on equity, return on assets, balance sheet total and various liquidity indicators. The rating system of Standard and Poor's developed for financial institutions and insurers is similar in terms of the variables used, but has a different structure (*Tripolitakis et al. 2015*), which weights three modules together, i.e. the business risks, the financial risks and the credit, market and liquidity risks into one final rating. Finally, it is worth mentioning that the Basel-based Bank for International Settlements (BIS) also paid special attention to the difficulties of the rating of credit institutions in several analyses, emphasising the role of the macroeconomic environment and the regulatory circumstances, and thus e.g. support by the state or lack thereof (see e.g. *Packer – Tarashev 2011*).

As for the antecedents in Hungary, it can be stated that to date no rating systems dedicated to credit institutions and financial enterprises have been published, and thus this paper – as mentioned in the introduction – can be regarded as pioneering work in this respect. Consequently, here we only briefly review the publications in Hungary dealing with the analysis and modelling of corporate bankruptcy and default risks, since these models and approaches were developed specifically for non-financial enterprises, and their applicability to financial enterprises and

credit institutions fell outside the scope of our analysis; thus, presumably they would not be suitable for a really precise analysis of financial enterprises' risks. Without intending to be comprehensive, *Hajdu – Virág* (*1996, 2001*) presented their methodology developed for the estimation of the default risk of Hungarian small and medium-sized enterprises. Of the Basel 2 requirements, achieving as accurate as possible a separation effect was analysed as an objective in the publication of *Kristóf* (*2008*). Finally, in recent years the MNB's experts presented several approaches on the topic of corporate credit risk; of those, we would mention the publications by *Banai et al.* (*2013*), and *Bauer – Endrész* (*2016*).

In view of the fact that – in terms of regulation, operation and business model – the financial enterprise segment can be described by features which substantially differ from credit institutions in many respects, the authors of this paper developed the monitoring tool presented in detail below, solely on the sample of non-banking group member financial enterprises.

2.2.2. Model applied to the Hungarian financial enterprises segment

The exclusion of banking group member financial enterprises from the model is based on the economic consideration and observation that – due to reasons of reputational risk – a financial-credit institution group can far less afford for a persistently loss-making subsidiary – particularly if it operates in the market of the same country – to be subjected to liquidation or other legal proceedings with negative connotations than a financial enterprise operated by other type of owner. In addition, financial enterprises belonging to a credit institution group are often established with a view to optimising the capital and liquidity management of the respective group of institutions, i.e. for a completely different purpose than non-banking group member financial enterprises. Finally, in the past few years, mostly with a view to achieving cost synergies, several banking groups opted for the merger of the group-member financial enterprises with the group-leader institution, i.e. a reorganisation, essentially independent of the risk features, can be observed in this segment.

Prior to building the model, we contemplated the direct measurement of the quality of the loan portfolio underlying the financial enterprises, as an option, but we rejected this idea for several reasons. On the one hand, the regular reports of financial enterprises to the MNB essentially contain aggregated data on the receivables managed; detailed data are available only for shorter periods and do not contain the information necessary to assess portfolio quality. On the other hand, in most of the cases this information is not available to the financial institutions financing the financial enterprises; such information is typically not disclosed regularly, only within the scope of portfolio due diligence preceding acquisition. Finally, such model would be unsuitable for measuring the risks of financial enterprises pursuing workout activity.

In addition, consideration may be given to using the data of the balance sheet and income statement data included in the data supply to the MNB for the development of the rating model, in view of the fact that – compared to the structure of the reports included in the databases of the National Tax and Customs Authority (NTCA) and Opten – they reflect the nature of the financial services activity pursued by the institutions being reviewed. However, in developing the model our objective was to demonstrate that it may be also possible to build a reliable monitoring model based on the balance sheet data available to the credit institutions to support the measurement of refinancing risks.

Accordingly, in developing the monitoring tool we used the balance sheet and income statement of the NTCA database, and – as an output variable signalling risks and negative events – the negative event register of the Opten database. As presented in *Table 1,* the development sample included the NTCA reports for the period 2004–2011, while for validation purposes we used the NTCA reports for 2012–2014, since these were the years when negative legal events did occur in the segment. Finally, we included each financial enterprise in the sample until the date it submitted an NTCA report or until the occurrence of the first negative event, i.e. – in line with the actual observations – we anticipated no recurrence of liquidation / bankruptcy / etc. proceedings, i.e. negative legal event. An additional important modelling step, described later, was that upon assigning the rating, in the case of those financial enterprises that still existed in the respective year but failed to submit a report to the NTCA until their termination by a negative event, we allocated the occurrence date of the negative event to the last year of their existence (i.e. one year from the date of the last NTCA report). By contrast, when calibrating the probability of default and assigning the rating, financial enterprises with no NTCA report received the worst performing rating. As is demonstrated, neither procedure caused any distortion during the development (and use) of the monitoring tool; the latter, i.e. downgrading the rating due to a missing report, is in line with the practice of rating allocation to the supervised institutions (i.e. the "override" practice when negative information comes to light in respect of the enterprise).

In developing the monitoring tool, we used logistic regression based on the consideration that the intuitive measurement of the economic (log)linear risk, i.e. rising monotonously by variable, and the reliable measurement of the effects differing from them is not permitted by the low number of elements in the sample. The estimation of the weight of the variable selection and the logistic regression was performed in full on the development sample, i.e. on the NTCA reports for the period 2004–2011; we used the validation sample solely for time-barred backtesting. In this way, the ratio of the development and the validation samples

is roughly 70–30 per cent, which – in terms of model validation – complies with the best practices described in the literature (*Hastie et al. 2008*).

Frequentist parameter estimation

During modelling, which was performed in the manner described in the previous subsection, we estimated the logistic regression parameters on the development sample (NTCA reports for 2004–2011) using the maximum likelihood method, known in the literature, by maximising the following expression (*Agresti 1990*):

$$L\left(data\middle|\theta\right)=\sum_{i=1,y_i=1}^{N}\log P\left(x_i\right)+\sum_{i=0,y_i=0}^{N}\log\left(1-P\left(x_i\right)\right), \tag{1}$$

where $\log P(x_i)$ is the logarithm of the likelihood of the occurrence of the respective category attribute as a function of the acquired value of the independent variable, (N) summarised for all observations.

Upon variable selection, in the first step we examined the ranking strength of each variable of the NTCA reports (balance sheet and income statement) in the development sample, and then in the second step, we generated from the variables strongest in development sample the variables corresponding to the economic logic and best covering the risks to be measured. Upon generating the compound variables, it was a key consideration that the performance of the model created by the compound variables should not be weaker than the ranking power obtained with strongest individual variables. Finally, in the case of the compound variables we managed the outliers – similarly to the corporate monitoring tool – by logarithmisation,[5] and using the appropriate method (*Liao – McGee 2003*) we also standardised the variables (*Hong – Ryu, 2006*), i.e. established their relative strength. *Table 2* presents the model estimated on the basis of these criteria and procedures.

[5] In the case of all compound variables (x), we performed the following transformation: asinh(x/2), which is approximately similar to the logarithmisation.

Table 2
Parameters and descriptive statistics of the logistic regression estimated on the development sample, and the standardised weights

Variable	Estimated parameter	Standard error	Significance	Expected sign	Risk	Standardised weight of variables
ROA = Balance sheet profit / Balance sheet total	–0.3276	1.0614	0.7575	–	Profitability	4.80%
Long-term return = ((Retained earnings – Impairment recognised on receivables) / (Book value of receivables)	–0.4150	0.1024	5.09e–05	–	Profitability, Credit risk	27.69%
Short-term liquidity = Short-term liabilities / Liquid assets	0.2292	0.0671	0.0006	+	Liquidity	26.98%
Average operating P&L per FTE = Operating P&L / Headcount	–0.0598	0.0308	0.0519	–	Profitability, Credit risk	18.25%
Net depreciation rate = (Value of investments deployed in the reporting year – Depreciation recognised in the reporting year) / (Intangible asset + Tangible assets)	–0.3964	0.1285	0.0020	–	Operational risk	22.29%
Intercept	–5.6751	0.4493	2.00E–16			

Source: Calculated on the basis of the samples from the NTCA database (years 2004–2011) and the Opten database (years 2004–2012)

As is evident, the monitoring tool measures almost all relevant risks of the financial enterprises by a proper index. As presented in *Annex 1,* there is a weak cross correlation between the variables, i.e. the selected indicators cover different risks.

Table 3
Ranking power of the monitoring tool on the development and the validation sample

			1-year forward-looking negative event ratio				
Year of the NTCA report (reference period: 31 December)	Number of financial enterprises (not belonging to a banking group)	Negative events	Negative event ratio (per cent)	AUC (sample)	AUC/year	AUC 95 per cent bootstrap confidence interval	Sample
1992	8	0	0.00%				
1993	10	0	0.00%				
1994	11	0	0.00%				
1995	11	0	0.00%				
1996	15	0	0.00%				
1997	38	0	0.00%				
1998	49	0	0.00%				
1999	83	0	0.00%				
2000	106	0	0.00%				
2001	118	0	0.00%				
2002	123	0	0.00%				
2003	135	0	0.00%				
2004	157	2	1.27%	0.8285	0.7774	0.7379–0.9190	development
2005	166	1	0.60%		0.6242		
2006	184	1	0.54%		0.9727		
2007	201	4	1.99%		0.9201		
2008	211	1	0.47%		0.6857		
2009	213	1	0.47%		0.9717		
2010	212	4	1.89%		0.7115		
2011	212	6	2.83%		0.894		
2012	213	4	1.88%	0.9494	0.9737	0.9182–0.9912	validation
2013	220	4	1.82%		0.9329		
2014	223	2	0.90%		0.9389		
2015	215	0	0.00%	Cannot be calculated in the absence of negative event			
2016	220	1	0.45%	0.9132	0.9132	Not calculated	teszt

Note: Risk ranking power groups based on AUC: red: weak (0.5–0.6), yellow: medium (0.6–0.7), orange: strong (0.7–0.8), green: very strong (>0.8).

Source: Calculated based on the databases of the National Tax and Customs Administration (NTCA) and Opten

Based on *Table 3*, the monitoring tool has distinctly strong ranking power, even when broken down into years, both based on the development and on the validation sample. This also means that the developed tool is stable and can be used in the short run as well.

Furthermore, based on *Table 2,* essential economic conclusions can also be drawn in the case of the various constellations of variables; e.g. it is possible that a financial enterprise realises adequate profit in a given year (or as the case may be, in the years since its establishment), but at the same time, if it manages to achieve this with low efficiency per employee and by postponing the investments, it inevitably raises doubts concerning its long-term viability, since these latter two variables will deteriorate the rating of the financial enterprise through the deterioration of its current year and long-term profitability ratio.

As the very last step, we also examined whether the allocation to the risk categories, defined on the development sample with the help of the decision tree (*Joopia 2016*) was also stable on the validation sample. Based on *Table 4*, which – as mentioned before – in the case of missing NTCA report manages the increased risk by reclassification, after the date of the NTCA report the risk classification by rating categories is stable both for the one-year and the two-year output window.

Table 4

Risk categories created on the basis of the monitoring tool and the 1-year and 2-year negative event ratio in the individual risk categories

2-year negative event ratio	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015 (not a full year)	Average 2004-2014 (# weighted)
1	0.00%	0.93%	0.83%	0.00%	0.00%	0.79%	3.36%	1.54%	0.00%	0.69%	0.65%	0.00%	0.79%
2	2.04%	0.00%	2.22%	3.70%	2.04%	2.00%	3.85%	2.17%	0.00%	4.76%	5.41%	0.00%	2.58%
3	0.00%	7.14%	0.00%	0.00%	0.00%	0.00%	4.17%	5.26%	9.09%	0.00%	9.52%	0.00%	3.45%
4	14.29%	0.00%	25.00%	33.33%	0.00%	16.67%	17.65%	23.53%	21.43%	22.22%	10.00%	0.00%	18.02%
5	0.00%		100.00%		100.00%	100.00%	100.00%	100.00%	100.00%	50.00%	100.00%		81.82%
Sector	1.27%	1.20%	2.70%	1.99%	0.94%	2.34%	5.16%	4.23%	3.29%	2.73%	3.13%	0.00%	2.71%

1-year negative event ratio	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015 (not a full year)	Average 2004-2014 (# weighted)
1	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
2	2.04%	0.00%	0.00%	3.70%	0.00%	0.00%	1.92%	2.17%	0.00%	0.00%	0.00%	0.00%	0.99%
3	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	4.17%	5.26%	0.00%	0.00%	9.52%	0.00%	1.97%
4	14.29%	0.00%	12.50%	16.67%	0.00%	8.33%	5.88%	23.53%	21.43%	22.22%	0.00%	0.00%	12.61%
5	0.00%		100.00%		100.00%	0.00%	100.00%	100.00%	50.00%	50.00%	100.00%		63.64%
Sector	1.27%	0.00%	1.08%	1.49%	0.47%	0.47%	1.88%	3.29%	1.88%	1.36%	1.34%	0.00%	1.35%

Note: The coloured cells indicate the risk reclassification in the case of those 5 financial enterprises that failed to submit NTCA report for one or two years. Risk categories: green: moderate, orange: low, yellow: significant, red: high. Brown: development sample, blue: validation sample.

Source: Calculated based on the databases of the National Tax and Customs Administration (NTCA) and Opten

During the development of the monitoring tool, another important criterion, which was not mentioned before, was that the rating system should respond to the current risk status of the institutions as sensitively as possible, i.e. map the changes in the risks of the individual institutions as much as possible. Since the tool may be used within the scope of continuously monitoring institutions, the goal is to capture the current situation of the institutions, i.e. to create a cycle-dependent rating system.

In order to assess the fulfilment of the aforementioned criteria, we compared the distribution between the individual rating categories, and the forecast and the actually incurred negative event ratios. *Table 5* presents the distribution of the financial enterprises between the individual rating categories. The analysis shows strong migration between the rating categories, which, however – as presented in *Table 4* – does not reduce the ranking power of the 2-year forward-looking classification. That is, although from one year to the next the migration between the rating categories is strong, this takes place in line with the increase and decrease in the short- and medium-term risks of the individual institutions and financial enterprises, mapping such changes. Consequently, this means that, based on the rating of the monitoring tool, an accurate relative view (risk of the financial enterprises compared to each other) and absolute view (degree of the risks at the individual and sector levels) can be obtained every year on the riskiness of the individual enterprises and the entire financial enterprise sector. In addition to this, since the rating is built solely on compound indices, based on balance sheet and income statement data, the additional, arbitrary sub-segmentation of the financial enterprises is also possible, e.g. assessing the risks by the licensed scope of activity; selecting the deteriorating enterprises, with continuously downward migrating rating and the deeper analysis of the risks inherent in their processes, etc.

Table 5
Distribution of financial enterprises between the rating categories based on the classification by the monitoring tool

Number of financial enterprises (not a banking group member)	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total (total NTCA reports)
1	88	108	121	123	137	127	119	130	136	145	155	161	1.389
2	49	41	45	54	49	50	52	46	39	42	37	37	504
3	12	14	10	18	17	24	24	19	22	22	21	10	203
4	7	3	8	6	8	12	17	17	14	9	10	7	111
5	1		1		1	1	1	1	2	2	1		11
Total	157	166	185	201	212	214	213	213	213	220	224	215	2 218

Distribution	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	56%	65%	65%	61%	65%	59%	56%	61%	64%	66%	69%	75%
2	31%	25%	24%	27%	23%	23%	24%	22%	18%	19%	17%	17%
3	8%	8%	5%	9%	8%	11%	11%	9%	10%	10%	9%	5%
4	4%	2%	4%	3%	4%	6%	8%	8%	7%	4%	4%	3%
5	1%	0%	1%	0%	0%	0%	0%	0%	1%	1%	0%	0%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Note: The coloured cells indicate the risk reclassification in the case of those 5 financial enterprises that failed to submit NTCA report for one or two years. Risk categories: green: moderate, orange: low, yellow: significant, red: high. Brown: development sample, blue: validation sample.

Source: Calculated based on the databases of the National Tax and Customs Administration (NTCA) and Opten

As a supplement to the table above, *Annex 2* presents the negative event ratio forecast for 1 year ahead, shown in *Table 5*, weighted by the rating distributions of the respective year, comparing it with the negative event ratio actually incurred within 1 year from the date of the NTCA report. Based on *Annex 2*, not only is the cycle-dependent nature of the monitoring tool shown repeatedly, but it is also shown that no further calibration is necessary in respect of the likelihood of the negative event, since it properly maps the actually incurred negative events both in terms of their level and dynamics, and the ratio thereof in the case of the non-banking group financial enterprises failing to submit the NTCA report. Nevertheless, in view of the low ratio of negative events, combining the risk monitoring into 3 categories, e.g. it is worth using 3 risk categories created logically from category 1, categories 2–3 and categories 4–5, since in this case, already on the 2-year forward looking horizon we obtain monotonous risk ranking in each year, with the exception of one year (this is illustrated visually by *Tables 4 and 5*).

Bayesian parameter estimation

When there is a low number of events (the less frequent category, in this publication the legal negative event) the frequentist parameter estimation is knowingly uncertain, because it is difficult to quantify it. Based on the relevant literature there are several rules of thumb. *Peduzzi et al.* (*1996*) deem necessary to have a minimum $t_n = \frac{10k}{p}$ sample size for the proper estimation of the parameter, where n is the sample size, k is the number of the independent variables and p is the event ratio. In our case, p is 1.28 per cent on the development sample (NTCA report sample for 2004–2011), while $10k$ is 50, that is, in the opinion of the authors a set of n = 3,890 elements would be necessary for reliable estimation of the parameters, and the set of 1,556 elements in the development sample only amounts to roughly 40 per cent of this. At the same time, in a more recent publication, *Vittinghoff et al.* (*2007*), based on wide-ranging simulation tests, find the aforementioned rule overly strict, and they mentioned primarily the too frequent occurrence of the Type II error as a problem, even when, in accordance with the above $k < 5$. Due to the foregoing, and the excellent performance of the model on the already described time-barred validation sample, the model risk is immaterial.

In summary, as mentioned here as well, the international literature also highlights the problems of the frequentist parameter estimation, which include the significance-related issues (Type I and II errors), the uncertainty arising from the point estimate nature of the parameters and the lack of their predictive distribution, and other related philosophical questions – whether it is right to define probability as a frequency in such cases when samples cannot be created through reproduction even in theory (*Jaynes – Bretthorst 2003*). The discussion of these problems is well beyond the scope of this publication; however, as the economic time series and databases – and thus, particularly the data range used in this publication – are

unique, with a relatively low number of sample elements and events, it is worth also using the Bayesian estimation commonly applied in cases of this nature. This procedure captures the uncertainty inherent in the estimated parameter values through credibility intervals rather than through the significance level; it allocates predictive distribution to the parameters and through this to the forecast values of the output variable. In addition, by channelling the already available knowledge into the estimation, it provides a more accurate representation of the probabilities that can be defined based on the sample and the expert knowledge (probability of the model compared to the alternatives, predictive distribution of parameters, etc.).

As is well-known, the Bayesian parameter estimation provides the posterior distribution of the parameters based on the parameter's given distribution on the basis of our preliminary knowledge ($P(\theta)$) and the model specified in the respective manner ($P(adatok|\theta)$):

$$P(\theta|data) = \frac{P(data|\theta)p(\theta)}{\sum_{\theta'}^{\Theta} P(data|\theta')P(\theta')}, \tag{2}$$

i.e. according to the Bayesian procedure, we update our preliminary knowledge of the world, based on the newly received evidence and information (*MacKay 2003*). In this case, in respect of our knowledge prior to the development sample we assume that it is essentially non-informative – for the intercept of the logistic regression and weight parameters we determined normal distribution still allocating substantial probability to a wide range of the parameters, assuming the multidimensional independence upon defining the prior distribution:

$$P(\theta) \sim N(0,10). \tag{3}$$

Based on (1), (2) and (3), eliminating the normalising constant from equation (2) and using the Markov chain Monte-Carlo method (*MacKay 2003*), we obtain the prior parameter distribution under (3) and the posterior distribution, which may be simulated on the basis of the development sample, by applying logistic regression and the variables already presented above:

$$P(\theta|development\ data) \propto L(development\ data|\theta)\ N(0,10). \tag{4}$$

During the simulation, starting from a point of the prior distribution defined by a random draw, we drew 25,000 elements from the posterior distribution, and discarded the first 2,500 elements upon the calculation of the posterior statistics (also known in the literature as "burn-in"). As the last step, in order to assess the parameters and through that the stability of the model, on the validation sample, assuming the multidimensional normality of the (4) posterior parameter distribution

(i.e. using multidimensional normal distribution during the Laplace approximation of the posterior distribution), we performed the estimation on the validation sample as well, as follows:

$$P\left(\theta \middle| validation\ data\right) \propto L\left(validation\ data \middle| \theta\right) P\left(\theta \middle| development\ data\right). \qquad (5)$$

In accordance with (5), we updated the previous information based on the newly received information base, in line with the Bayesian methodology and the related best practice. This procedure proved its viability in several practical applications, including the analysis of such extremely rare events as e.g. the detection of German submarines in the huge area of the Atlantic Ocean *(Koopman 1946)*, in the course of which the US military searched for submarines of a few ten meters lengths within cells of 200 x 50 miles. This search efficiency was significantly improved by the Bayesian methodology, also used in this publication, and the more efficient utilisation of the information as part of that.

The results of the Bayesian estimate and the comparison of those with the frequentist parameter estimation shown in *Table 2* is presented in *Table 6*.

Table 6
Parameters estimated by the frequentist and the Bayesian method on the financial enterprises' development sample (NTCA reports for 2004–2011) and validation sample (NTCA reports for 2012–2014)

	Maximum likelihood development		Bayesian estimation development		Bayesian estimation validation	
Variable	**Estimated parameter**	**Standard error**	**Estimated parameter**	**Standard error**	**Estimated parameter**	**Standard error**
Intercept	–5.675	0.449	–5.779	0.476	–5.764	0.571
ROA	–0.327	1.061	–0.659	0.922	–0.649	0.888
Long-term return	–0.415	0.102	–0.396	0.11	–0.393	0.114
Short-term liquidity	0.229	0.067	0.222	0.07	0.221	0.085
Average operating profit per FTE	–0.059	0.030	–0.064	0.034	–0.062	0.036
Net depreciation rate	–0.396	0.128	0.386	0.139	–0.386	0.143

Source: Calculated based on the databases of the National Tax and Customs Administration (NTCA) and Opten

Based on Table 6, the maximum likelihood, the Bayesian estimation performed on the development sample using the non-informative prior, and the Bayesian estimate performed with the informative priors – channelling in the former information – on the validation sample return similar results. The only exception is the return on assets (ROA) ratio, the estimated value of which significantly differs on the basis of the two methodologies. This is attributable to the fact that it is not a strong variable in either of the methodologies, which is also confirmed by the value of the standardised regression weight (4.8 per cent) shown in *Table 2.*

Nevertheless, based on both the time-barred cross validation used during the frequentist estimation and the parameter estimation according to the Bayesian methodology, a stable rating system with strong predictive power can be built. The only difference in the two approaches lies in the weighting of the return on assets – having a low weight anyway, but retained in the model due to expert considerations – which, however, obviously does not change the adequacy of the model's forecast power.

2.3. Warning model based on risk segmentation

As we mentioned in the Subsection of *Section 2.2* entitled *Frequentist parameter estimation*, the risk segmentation can be made more straightforward by applying a three-part warning system created from categories 1, 2–3 and 4–5. In this way, the 2-year negative event ratio will be monotonous in almost all years and returns a straightforward result, which is easier to interpret. The "green" category 1 contains the good- quality, low-risk financial enterprises eligible for financing, the "yellow" category 2 contains financial enterprises that will potentially become of high risk, while "red" category 3 includes particularly problematic, high-risk enterprises (*Table 7*). Based on the warning model, it may be easier for the financing entities to make decisions in a more substantiated manner which is easier to monitor – e.g. the gradual phase-out of the financing of financial enterprises with "yellow" and "red" ratings, and enhanced monitoring of financial enterprises belonging to these categories.

Table 7
Warning model for the risk monitoring of the non-banking group financial enterprises

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
1	0.0%	0.9%	0.8%	0.0%	0.0%	0.8%	3.4%	1.5%	0.0%	0.7%	0.6%	0.0%
2	1.6%	1.8%	1.8%	2.8%	1.5%	1.4%	3.9%	3.1%	3.3%	3.1%	6.9%	0.0%
3	12.5%	0.0%	33.3%	33.3%	11.1%	23.1%	22.2%	27.8%	31.2%	27.3%	18.2%	0.0%
	1.27%	1.20%	2.70%	1.99%	0.94%	2.34%	5.16%	4.23%	3.29%	2.73%	3.13%	0.00%

Source: Calculated based on the databases of the National Tax and Customs Administration (NTCA) and Opten

3. Conclusion

In view of the fact that financial enterprises manage no client funds, the risk occurs primarily at the financing or owner credit institutions; in addition, consumer protection risks may also occur in the case of these institutions.

The importance of the developed tool lies in the fact that – in the case of non-banking group financial enterprises – it presents a stop-gap monitoring model based on balance sheet and income statement data, also available to the Hungarian banks, which may be an efficient additional tool for measuring refinancing risks. All of this information may be useful and valuable both for investors and risk assessment experts.

It should be noted that the tool can also be used as an early warning system, as needed. Despite the fact that the model essentially uses *"point-in-time"* variables, combining it based on Table 4 into 3 risk categories (e.g. creating 3 categories from category 1, 2–3 and 4–5), it shows the relative riskiness of the respective enterprise on a two-year time horizon as well, and this time is sufficient for making proper risk management decisions or – upon degradation of the risk monitoring – for the review and override of those.

Finally, the future enhancement of the monitoring tool may include the channelling of additional information, such as the use of negative information related to the respective financial enterprise. Such information may include court procedures initiated against the enterprise, the queued items on the bank account or negative changes in the management of the financial enterprise. Another potential development direction may include the channelling of micro data into the risk measurement of financial enterprises. The latter would be based on the rating of the household and – primarily in the case of financial enterprises with a corporate profile – corporate transactions and clients financed by the respective financial enterprise, i.e. it would provide an additional balance sheet analysis criterion for the rating of financial enterprises, in addition to the balance sheet indicators already used.

In addition, based on preliminary surveys and calculations, the model may also support the measurement of the relative riskiness and business efficiency of banking group financial enterprises (in view of the fact that banking groups typically organise financial enterprises for a specific activity or business process, e.g. leasing, factoring, etc.), and thus it may be worth analysing this as well in more detail.

References

Agresti, A. (1990): *Categorical Data Analysis, 3rd Edition*. John Wiley & Sons, New York.

Banai, Á. – Hosszú, Zs. – Körmendi, Gy. – Sóvágó, S. – Szegedi, R. (2013): *Stressztesztek a Magyar Nemzeti Bank gyakorlatában* (*Stress tests in the Magyar Nemzeti Bank's practice*). MNB Occasional Papers 109.

Bauer, P. – Endrész, M. (2016): *Modelling Bankruptcy Using Hungarian Firm-Level Data.* MNB Working Papers 122.

Broos, M. – Carlier, K. – Kakes, J. – Klaaijsen, E. (2012): *Shadow Banking: An Exploratory Study for the Netherlands.* DNB Occasional Studies. https://www.dnb.nl/en/binaries/DNB_OS_10-05_uk_tcm47-281218.pdf. Downloaded: 2 January 2017.

Hastie, T. – Tishbirani, R. – Friedman, J. (2008): *The Elements of Statistical Learning, 2nd Edition*. Springer Verlag, Berlin.

Hajdu, O. – Virág, M. (1996): *Pénzügyi mutatószámokon alapuló csődmodell-számítások* (*Bankruptcy model calculations based on financial indicators*). Bankszemle, 15(5): 42-53.

Hajdu, O. – Virág, M. (2001): *A Hungarian Model for Predicting Financial Bankruptcy*. Society and Economy in Central and Eastern Europe, 23 (1–2): 28–46.

Hill, N. – Auquier, R. (2014): *Proposed Bank Rating Methodology.* Moody's Report Number: 171718. https://www.moodys.com/microsites/gbrm2014/RFC.pdf. Downloaded: 2 January 2017.

Hong, C.S. – Ryu, H.S. (2006): *Information Theoretic Standardised Logistic Regression Coefficients with Various Coefficients of Determination.* The Korean Communications in Statistics, 13(1): 49–60. https://doi.org/10.5351/CKSS.2006.13.1.049

Jaynes, E. – Bretthorst, L. (2003): *Probability Theory – the Logic of Science*. Cambridge University Press, Cambridge.

Joopia, H. (2016): *Optimal Binning for Scoring Modelling.* http://www.scoringmodeling.com/. Downloaded: 2 January 2017.

Koopman, B. (1946): *Search and Screening*. OEG Report No.56.

Kristóf, T (2008): *A csődelőrejelzés és a nem fizetési valószínűség számításának módszertani kérdéseiről* (*Some methodological questions of bankruptcy prediction and probability of default estimation*). Közgazdasági Szemle, 55 (May): 441–461.

Liao, J. – McGee, D. (2003): *Adjusted Coefficients of Determination for Logistic Regression.* The American Statistician, 57(3): 161–165. https://doi.org/10.1198/0003130031964

MacKay, D. (2003): *Information Theory, Inference and Learning Algorithms.* Cambridge University Press, Cambridge.

MNB (2016a): *Recommendation 11/2016 (XII.1) of the Magyar Nemzeti Bank on the limitation of exposures to organisations performing shadow banking activity.* MNB 11/2016. https://www.mnb.hu/letoltes/11-2016-shadow-banking.pdf. Downloaded: 2 January 2017.

MNB (2016b): *Risk Outlook for Non-Bank Financial Sectors.* MNB 2016, pp. 51–53. http://www.mnb.hu/letoltes/publikalando-jelentes-v4-digitalis.pdf. Downloaded: 3 January 2017.

MNB (2017): *Insurance, funds and capital market risk report, June 2017* MNB. pp. 58–65. http://www.mnb.hu/letoltes/kocka-zati-jelente-s-2017-digita-lis.pdf. Downloaded: 18 October 2018.

MNB (2018): *Insurance, funds and capital market risk report, 2018.* MNB 2018., pp. 61–67. http://www.mnb.hu/letoltes/kockazati-jelentes-2018-0613-vegleges.PDF. Downloaded: 18 October 2018.

Packer, F. – Tarashev, N. (2011): *Rating methodologies for banks.* BIS Quarterly review, June. http://www.bis.org/publ/qtrpdf/r_qt1106f.pdf. Downloaded: 2 January 2017.

Peduzzi, P. – Concato, J. – Kemper, E. – Holford, T.R. – Feinstein, A.R. (1996): *A simulation study of the number of events per variable in logistic regression analysis*. Journal of Clinical Epidemiology, 49(12): 1373–1379. https://doi.org/10.1016/S0895-4356(96)00236-3

Tripolitakis, G. – Angelopoulos, G. – Wu, Y. – Baldassari, G. (2015): *CreditModel Financial Institutions.* Standard and Poor's Capital IQ. http://marketintelligence.spglobal.com/documents/our-thinking/research/creditmodel-financial-institutions-a-state-of-the-art-scoring-model-for-banks-and-insurance-companies.pdf. Downloaded: 2 January 2017.

Vittinghoff, E. – McCulloch, C. (2007): *Relaxing the rule of ten events per variable in logistic and Cox regression*. American Journal of Epidemiology, 165(6): 710–718. https://doi.org/10.1093/aje/kwk052

Annex

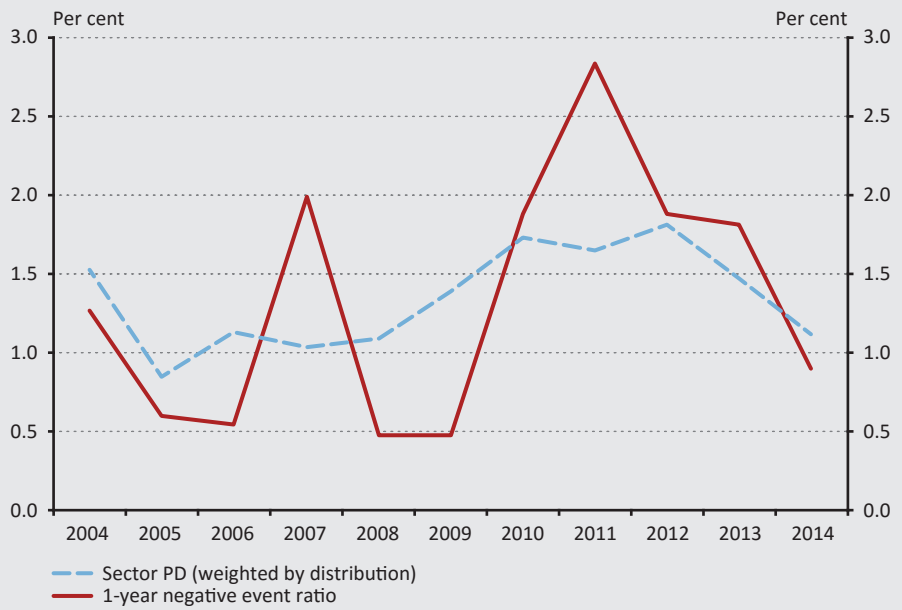
Annex 1: Cross correlation test of the used variables

Metrics: Spearman rho					
Development sample	**ROA**	**Long-term return**	**Short-term liquidity**	**Pre-tax profit/ loss per FTE**	**Net depreciation rate**
ROA		0.389	–0.048	0.357	0.057
Long-term return	0.389		–0.116	0.182	0.022
Short-term liquidity	–0.048	–0.116		–0.029	–0.022
Pre-tax profit/ loss per FTE	0.357	0.182	–0.029		–0.011
Net depreciation rate	0.057	0.022	–0.022	–0.011	

Validation sample	**ROA**	**Long-term return**	**Short-term liquidity**	**Pre-tax profit/ loss per FTE**	**Net depreciation rate**
ROA		0.245	–0.015	0.461	0.061
Long-term return	0.245		–0.070	0.120	0.172
Short-term liquidity	–0.015	–0.070		–0.029	–0.041
Pre-tax profit/ loss per FTE	0.461	0.120	–0,029		–0.048
Net depreciation rate	0.061	0.172	–0.041	–0.048	

Source: Calculated based on the database of the National Tax and Customs Administration (NTCA)

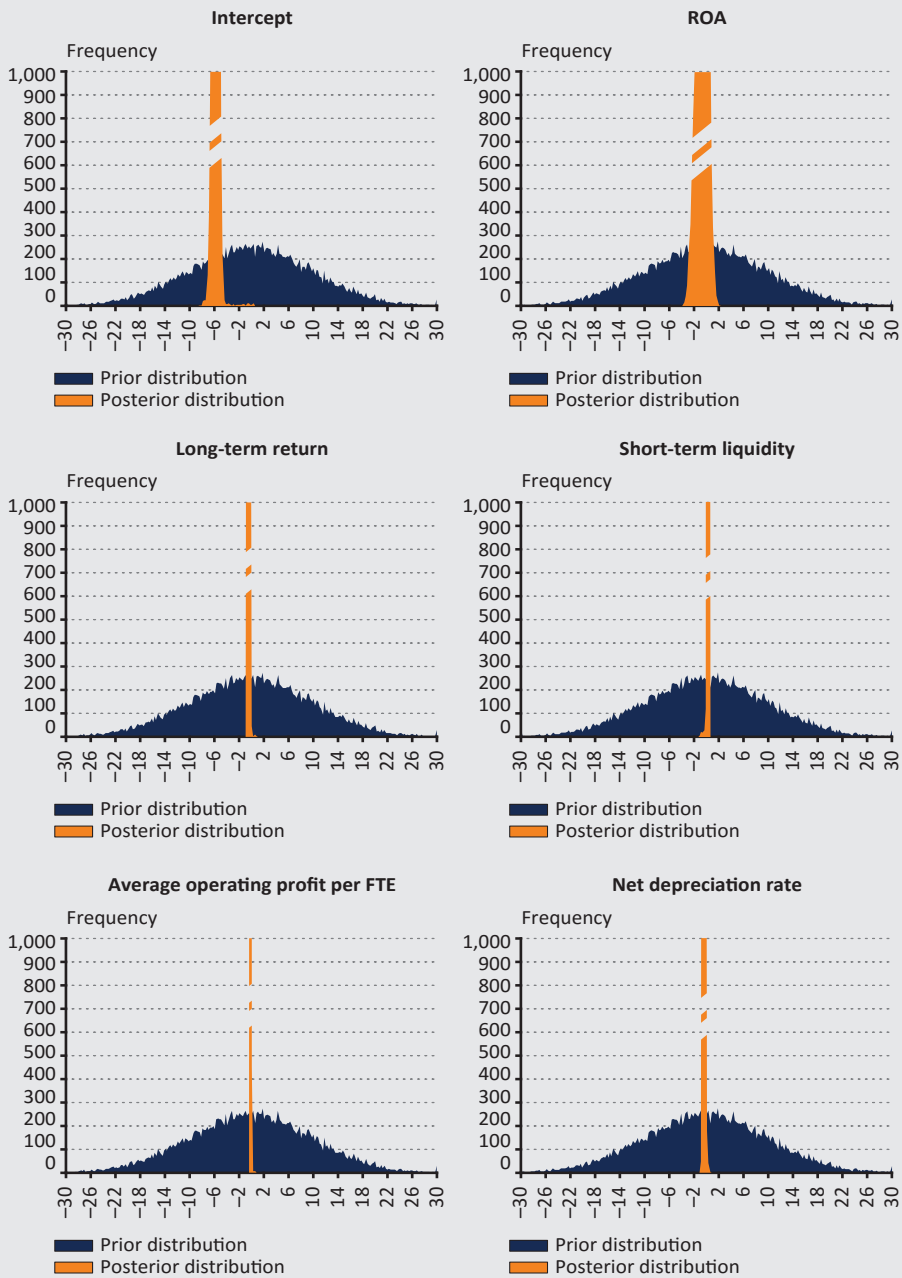
Annex 2: Actually incurred and forecast negative event ratio



Note: The rating was allocated on the basis of the NTCA report of the given year, while the PD was allocated to the individual rating categories based on the long-term average for 2004–2014. Until 2011 the development sample, in the years 2012–2014 the validation sample and the displayed time series.

Source: Calculated based on the databases of the National Tax and Customs Administration (NTCA) and Opten

Annex 3: Prior distributions applied on the development sample and the posterior distributions obtained based on the estimation during the Bayesian estimation



Source: Calculated based on the databases of the National Tax and Customs Administration (NTCA) and Opten

Time To Look at the State in a Different Way – Value Creation and Innovation in the 21st Century*

Pál Péter Kolozsi

Mariana Mazzucato:
The Value of Everything: Making and Taking in the Global Economy
Public Affairs, September 2018, p. 384
ISBN: 978-0-241-34779-9

What can be regarded as real value creation from a social perspective? Which economic operators play a prominent part in this process? Don't we overvalue the importance of the private sector in the field of innovation and easily forget about the state's added value? It is questions like these that Mariana Mazzucato, an outstanding representative of economists who are overturning pre-crisis dogmas with increasing success, undertook to answer in her latest work. In the book "The Value of Everything – Making and Taking in the Global Economy", the Italian-American economist, known as a strong critic of modern capitalism and mainstream economics, concludes that exploring the above issues and dilemmas should not start by performing economic analyses, but by answering a fundamental philosophical question, which was once also a major concern to economists: What does value mean? What makes anything, for example an activity, valuable? What makes this issue particularly relevant is the fact that we have barely overcome the global financial crisis, but the banking sector which ultimately caused the crisis is once again resplendent in its former glory. According to one example, Mazzucato repeatedly uses, a mirror is undoubtedly held up to us by the fact that just a year after a total collapse of the financial markets, Goldman Sachs chief Lloyd Blankfein – who was by no means an independent observer in the outbreak of the crisis – declared that his employees were "the most productive in the world". The masses of persons who lost their flats, jobs and existence due to the crisis certainly do not share the view of the star banker, and Mazzucato is clearly with them based on what is stated in her book.

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Pál Péter Kolozsi is a Head of Department at the Magyar Nemzeti Bank. E-mail: kolozsip@mnb.hu

Mazzucato claims nothing less than that most of the economic and social problems of our times and the ever-increasing inequalities can be attributed to a fundamental error of mainstream economics, i.e. the concept that those things and only those things are valuable if market mechanisms show them as valuable. This, however, is not evidence. Determining value on a market basis is a relatively new approach. Before the marginal revolution at the beginning of 19th century, a number of value theories, often rival, were developed by economists who were motivated by a much stronger philosophical interest at that time, and their work revolved primarily around this question of value. Typically, economics started from the concept that activities which create value can be considered as useful, and thus deserve to be promoted from a social perspective, and to that end, the notion of value and value creation had to be defined in some way. If we do not define value in an appropriate way, we might give preference not to value creation, but to value extraction, i.e. to unearned rents without real performance instead of well-deserved profit. This is indeed of critical importance, especially in terms of the redistribution of income and economic development, since economic policy decisionmakers are naturally influenced by the concepts and ideas of value and value creation.

In the first part of the book, Mazzucato presents the development of value theory, describing the resources and activities that economists from mercantilists and physiocrats through classicists to marginal neo-classicists used to regard as productive or unproductive, and how this distinction impacted the social policy and economy policy decisions and strategies of the given era. According to the marginal value theory, which is dominant today, value depends on the utility the consumer gets, and therefore it does not make sense to classify activities as valuable or valueless because the market will make this distinction. Anything that has a price has value, i.e. in contrast to the earlier view, it is not the case that value determines price but, on the contrary, price determines value which thereby depends on the scarcity of the given good. You get what the others think you deserve. Under this concept, basic notions also get a different perspective, for example rent is not an unearned income any longer, but a market imperfection that can be decreased by facilitating competition. The hollowing out of the notion of rent is one of the major theoretical changes in the history of economic thinking, according to Mazzucato. While even the classicists viewed it as an income from unproductive activity and therefore acted against it, neoclassical theory says that in a free market economy, all incomes are by definition productive – we just have to decrease administrative obstacles to market competition, because it is the cure for every problem.

Following this theoretical introduction, the author analyses the current economic order. One of the "negative heroes" of Mazzucato's book is the financial sphere. The UCL professor believes that financial deepening, deregulation and the huge enlargement of the financial sector is much more of an impediment to progress

than a facilitator. It is not by chance, she argues, that the financial sector was not considered a value creator before the emergence of modern capitalism since interest charged by banks reduced real economy income. Thus, in contrast to today's view, the banking sector was not seen as a profitable economic sector but as a dead-weight cost. According to Mazzucato's analysis, most banks are probably the biggest rent-seekers of economy, which do not create value, but extract values from others, the real value creators. Banking income differs anyway in its character from real economy income since it mostly comprises unpriceable elements, and its main source is money creation by commercial banks. For a long time, mainstream thinking practically denied or at least failed to acknowledge that banks create money independently of the state: according to the prevailing narrative, credit institutions are financial intermediaries, i.e. they only pass on savings to investors. For example, the Bank of England only acknowledged a few years ago, under the pressure of the 2008 crisis, that it is not the deposits that create loans but, on the contrary, loans made by banks create deposits. Of course, banks do not have unlimited capacity to create money, since lending has liquidity and capital requirements. However, this does not change the fact that banks mostly "make their living" by providing a monopolistic-oligopolistic service (establishing a bank is subject to authorisation, and the banking market in particular is highly concentrated), and thus they can charge unreasonably high prices. Mazzucato agrees with Keynes and Minksy who claimed that excessive financial dominance is dangerous and harmful, and banks should be subject to strong regulation ("big government, big bank"), as an abandoned financial sector may cause deep crises. Besides, the excessive expansion of fund managers and investment funds is also seen as problematic by the author ("money manager capitalism" and "casino capitalism", to use the words of Minsky), as in this case the financial sector derives an ever higher income from serving other financial firms or from speculation, and not from serving the real economy, which does not provide real added value from a social perspective.

Mazzucato dedicates a separate chapter to the financialisation of the real economy, the phenomenon that ultimately – due to the distortion of the notion of value – industrial companies and service providers also often generate higher income and profit from financial operations than from their core activity. This in itself would not necessarily pose a problem, but it may have consequences for corporate behaviour that do not serve the interests of society. For example, the author presents share repurchases, a common form of distributing corporate profits to shareholders as a particularly harmful practice. Mazzucato sharply criticises the idea attributed to Milton Friedman that the only job of a company is to maximise shareholder value – this favours short-term thinking (short-termism) over long-term thinking, supports speculation, restrains productive investments and ignores that owners are not the only group that matters for company, but also employees, business partners, the

community as the host of a company, civil society, i.e. all other stakeholders are relevant. According to Friedman, the reason why shareholders are key actors is that they bear the risks deriving from the company's business activities, and precisely for this reason they are entitled to profit. However, Mazzucato thinks that reality is much more complex than that. Corporate value creation is a collective process, and thus every party involved has its part in the success of the company.

In continuation of this reasoning, along with banks Mazzucato also does not spare the innovational sector. From her perspective, the big innovators and start-ups known today also present rents as profits in most cases. It is a fundamental problem that the mainstream approach ignores that innovation is a collective and cumulative process. In the current system, risks are borne by the community, while profits are distributed to privileged players in the private sector – warns the author, who believes that it is false and misleading to state that big innovations are born in garages in small American towns. In reality, they are rather the result of detailed scientific work carried out over several decades. The situation is further complicated by the fact the this basic research is usually carried out by state institutions and not by private companies, as the private sector does not take on the substantial capital requirements and risks involved. This structure is typical for the majority of innovations in the pharmaceutical industry, the Internet industry and bio- and nanotechnology – says Mazzucato, who claims that it is therefore doubtful whether the private profits generated in these industries are proportional to the invested private capital and the risks assumed by the private sector. The author's answer to this question is clearly no, and out of the harmful practices, she points out patents and trademarks which – in contrast to their original goals – no longer facilitate innovation , but create, almost exclusively, monopolies. According to Mazzucato, the enormous profit of big technology companies are also rents since they are de-facto monopolies, be it social networks or Internet search engines. These monopolies are based on network effects, that is, on the fact that many people use them. There is no real competition on these markets, which is not optimal at the level of society, since it results in overly high prices. In spite of this, state competition authorities do not act against this strong concentration. This observation is not affected either by the fact that these websites are often free for the first sight, because the correct interpretation here is that these companies make their living from the commercial resale of databases received from users for free. If something is free in the online world, users are not consumers but products, the author points out.

The closing part of the book deals with the question of what can be done in this situation, and concludes that we should first of all change our way of thinking. Mainstream thinking treats government as a necessary evil, believing that the state can only remedy market failures (and only to a limited extent, since it might easily

run into one of the government failures), and on the whole, government is not productive, and thus cannot create value. Mazzucato says this reasoning is false and not supported by the facts, but rather has its origin in an ideological position. In fact, the state plays an outstanding role in the operation of the market economy system as a whole, as well as in the development of markets, and in particular in the field of innovation and value creation. The author outlines the extent of the damage caused in public thinking by the spread of the public choice theory. The promotion of the supremacy of the market, the inertia and ineffectiveness of the state significantly reduced the size of the state and eroded the ethos of the public sphere. The latter led to a considerable decline in the self-evaluation of the state, and the government sector virtually began to stop "thinking big". This is particularly bad because it is precisely the task of the state to launch big projects and solve tasks that the private sector is not able or willing to solve. Just think of space research, the moon landing, the Internet, or basic research applied in the pharmaceutical industry. If we do not believe in the power of the state to create value, it will not be able to do so, but if we acknowledge its results, then it will. A state which decreases its capacity and is uncertain about itself is indeed less able to create social added value. Therefore, the aim should be a state that finds itself again – to that end, it is important to link the results achieved by the state to the state, and possibly not to any private sector players who just ably promote themselves. We need to recognise that the state does not only spend, but also invests and assumes risks, but that it can only benefit from the returns on its investments in an indirect manner at most, through a rise in tax revenues, due to the enrichment of the private sector. If we strive for an economic environment which is based on innovation and grows in a sustainable and inclusive manner, taking social and environmental limitations into account, then the status of the state must be restored both in people's heads and in actual income accounts.

According to Plato those who tell the stories rule the world, since our behaviour is largely determined by the common experience and common perception of our own jointly shared mental and intellectual frameworks. This view is shared by bestseller historian Yuval Noah Harari, who believes that social changes are shaped by an inter-subjective reality, which is nothing else but a set of stories, a common understanding that exists in the common mind of participants. The novelty of Mazzucato's book lies precisely in the fact that it questions the stories that modern capitalism is based on. We must rid ourselves of the ideological beliefs that we cannot argue about values. Moreover, we must acknowledge that a major part of innovation comes from the public sphere and not from the private sector, and the state should not be small and stand in the background, but rather be proactive and courageous. First of all, we need to ask ourselves what kind of world we would like to live in, and what kind of economy we would like to have. We have to reward activities and behaviour that facilitate the attainment of the objectives

that we defined, and the creation of real social added value. This is irreconcilable with a socio-economic order that favours unearned incomes, Mazzucato believes. This is because the free market does not mean a market free from the state, not even according to Adam Smith who was widely misconceived and misunderstood, but it means a market free from rent.

Alternatives for Europe's Future*

Alexandr Maxim Palicz

Joseph E. Stiglitz:
The Euro: How a Common Currency Threatens the Future of Europe
W. W. Norton & Company, 2016, p. 448
ISBN-13: 978-0393254020

Joseph Eugene Stiglitz is an American economist, a Nobel Prize-winning professor at Columbia University, and former chief economist and vice president of the World Bank. In 2001, he was awarded the Nobel Memorial Prize in Economic Sciences jointly with George A. Akerlof and A. Michael Spence for developing the basic theory for markets with asymmetric information. His research areas comprise income inequalities, management of financial risks, corporate governance and international trade. He is known for his critical views on the rise and regulation of globalisation, the "laissez-faire" economics approach, and international institutions (IMF, World Bank).

His book "The Euro: How a Common Currency Threatens the Future of Europe" describes the crisis of the euro area, and the extent of the recession and the slow pace of the recovery process. The author explains the economic, political and ideological reasons lying behind the debt crisis. He analyses the detrimental, often procyclical effects of the crisis management programmes of the so-called Troika (ECB – European Central Bank, EC – European Commission and IMF – International Monetary Fund) and comes up with several alternatives for the future of the euro area.

The 2008–2009 financial crisis which originated in the United States grew into a systemic debt crisis in the European Union, especially in the euro area. While the recession was followed by rapid growth in the Unites States, in the euro area the crisis developed into a systemic debt crisis which – in its most severe period – threatened to break up the euro zone. Stiglitz believes that the economic difficulties of the euro zone were primarily due to the incomplete institutional framework of the euro, or more exactly the euro zone. He points out that the establishment of the euro zone was primarily a political initiative, which was ahead of its time.

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Alexandr Maxim Palicz is an Analyst at the Magyar Nemzeti Bank. E-mail: palicza@mnb.hu

Although monetary policymaking was centralised in the Economic and Monetary Union, the necessary crisis management mechanisms – that would have made it possible to effectively handle asymmetrical shocks affecting the euro zone – were not established. He attributes the problem on the one hand to a lack of European solidarity, on the other hand to the economics approach prevailing at the time of the establishment of the euro zone, the widespread dissemination of neo-liberalism. In a neo-liberal approach, assuming efficient markets, there is no likelihood that significant systematic risks will build up and thus no serious crises can be expected. Even in times of a potential crisis, efficient markets would automatically converge to a new equilibrium, and thus there is no need for significant state intervention or state regulations.

According to the expectations of its founders, the optimal functioning of the euro zone established along neo-liberal principals was supposed to be ensured by the fulfilment of the Maastricht convergence criteria which, however, only imposed restrictions on public over-indebtedness, and did not mitigate the often excessive risk-taking of the private sector. Thus, a centralised monetary policy was implemented within the agreed framework and, in parallel, the room for manoeuvre in fiscal policies left to the national competence of the Member States was also restricted. Due to a fixed exchange rate between the Member States' currencies, in the event of a shock inherent to the operation of a market economy, the correction of imbalances appearing in the balances of payments was not possible through a shift in the exchange rate. In the absence of the option of external devaluation, countries could only restore their competitiveness by reducing domestic price levels and primarily by cutting wages. The reduction in wages could increase exports at the price of reducing domestic demand and thereby by increasing unemployment.

The economic model of Germany also bears responsibility for the serious balance-of-payments deficits which developed in eurozone Member States before the crisis. In the 2000s, wages in Germany were only raised to a lesser extent than economic growth and, as a result, the unit cost of labour decreased. At the same time, the euro exchange rate favoured German industry, because the euro was weaker than a separate German mark would have been. As a result of these impacts, the competitiveness of German industry improved as compared to other countries in the euro zone, which led to an unprecedented balance-of-payments surplus for Germany and, in parallel, a significant balance-of-payments deficit for the southern Member States.

Due to the centralised monetary policy, a shift in the exchange rate could not be applied to correct imbalances in the balance of payments. In the southern Member States, a more rapid rise in wages as compared to Germany led to a higher demand and inflation, and thus to a lower real interest rate, which resulted in robust capital inflows. However, these capital inflows did not serve to finance the real economy

and especially not to support SME lending, but rather led to the development of asset price bubbles. As a result of the 2008 crisis, these capital inflows dried up. Governments and banks of countries relying on these external funding sources were not able to renew their maturing debt, or only at excessive costs. The drying-up of capital inflows resulted first in Greece's insolvency. This case revealed, on the one hand, that use of euro did not automatically eliminate the country risk of Member States, and on the other hand, that the euro zone lacked mechanisms that could help Member States facing liquidity problems and their banking systems. Identification of these two facts started to produce extremely severe contagion effects on financial markets, not sparing even the returns on bonds in states that until then had been considered stable.

In federal states, it is usually the central bank that acts as a lender of last resort in such cases. In this function, the central bank may purchase government bonds or provide extra liquidity to support banks. In the EU, however, the ECB has no such powers, and thus Member States in trouble could not count on monetary policy support. Moreover, there was no fiscal transfer mechanism within the euro zone to mitigate the crisis. Finally, the Member States' own fiscal space was restricted due to the fiscal rules in place. These factors together resulted in a severe recession and extreme social tensions.

While the difficulties of Member States facing payment problems worsened due to the structure of the euro zone, more resilient countries that were less affected by the crisis even benefited from the debt crisis due to a decrease in interest expenditures. Thus, in contrast to the initial promises, the euro did not contribute to the harmonious development of the Member States. On the contrary, by centralising monetary policy and eliminating the possibility of exchange rate corrections, it amplified the differences among countries: it led to the unfolding of creditor and debtor countries within the zone, and thereby to conflicting national interests, a lack of confidence, an erosion of solidarity, and ultimately to a loss of support for the process of European integration, and to the strengthening of eurosceptical parties.

The third part of the book demonstrates that the crisis management programmes of the Troika mostly failed, and did not support the economic recovery of growth in the affected countries or the expansion of employment. The reforms of the Troika – mainly driven by neo-liberal ideology – wished to reinstate balance by improving the primary balance of those Member States that got into trouble. They wished to achieve these objectives mostly through steps which hit vulnerable social groups more severely, furthermore through so-called structural reforms, that fundamentally change the entire economic framework of Member States. According to the Troika, the temporarily painful reforms, if carried out, would have ultimately resulted in an improvement in Member States' competitiveness, growth in exports, and thereby an improvement in the balance of payments. However,

export volumes only increased to a limited extent, while the implementation of reforms resulted in an extreme economic downturn, severe social tension and political cost. The Troika attributed the serious downturn to the inappropriate implementation of the programmes. However, based on the similar outcomes of several countries, it cannot be convincingly stated that the programmes would have efficiently supported the recovery of insolvent countries. Nonetheless, they were able to restore the primary balance, and in several cases there was even a significant surplus. Furthermore, they enabled governments to bail out their countries' banks, ensuring the settlement of outstanding amounts owed to creditors, often German or French financial institutions. It appears therefore that the aim of the Troika was not to restore the economies of the Member States in trouble, but rather to help creditors, considering that any hypothetical but in fact absolutely necessary debt-restructuring was consistently and categorically rejected by creditors, mostly Germany.

The structural reforms urged by the Troika did not treat the underlying problem of Member States facing payment difficulties and the lack of possible corrective mechanisms. In the absence of an easing of monetary or fiscal policy and the function of ECB as a lender of last resort, governments with liquidity problems implemented – in vain – extremely costly structural reforms to improve the flexibility of their labour markets. This had no significant impact, except that it substantially increased unemployment. The programmes undermined social security, in addition to increasing income inequalities between the Member States, which impaired the efficient functioning of the economy. Finally, they also contributed to dividing the euro zone into creditor and debtor states, where the equality of the Member States is undermined, and creditor countries dictate the directions to be followed, often against the expectations and preferences of the debtor countries.

Yet, as Stiglitz argues, the functioning of the euro zone can be restored, and if there is sufficient political will, it is possible to set up a monetary union that is beneficial for all Member States, and promotes growth and full employment. The author sets out three possible approaches. A potential option is to deepen European integration and to *complete* the eurozone institutional system, including the missing crisis management mechanisms. Another option is a *smooth divorce* whereby through the exit of one or more Member States, the euro zone would be divided into smaller currency zones. Finally, a *flexible euro zone* could be created where the exchange rates of the Member States' currencies would fluctuate against each other in a pre-determined band, abandoning the rigid policy of pegged currencies.

To complete the institutional system of the euro zone, Stiglitz recommends the following structural reforms:

1) Creating a banking union with a single deposit insurance scheme. The resulting banking systems with a uniform level of resilience would remove the burden imposed on Member States to bail out their banks, and at the same time, would leave considerable fiscal space for offsetting the negative effects of potential crises.

2) Similarly to the banking union aimed at preventing capital outflows from the countries' banking systems, it is necessary to mutualise European debts to prevent labour migration. As long as the issues of government debt belong to administrative units, more mobile, mostly younger social groups may move to member states with lower government debt levels, thus with lower tax levels and better living conditions, further deepening the divisiveness between creditor and debtor countries in the EU. By contrast, issuing mutually guaranteed debts would allow for the sharing of debts, since the repayment burdens of debtor countries could be reduced, which would leave more scope for applying demand stimulation economy policy tools.

3) A stabilisation fund, that is, an EU solidarity fund for stabilisation purposes. This could be used to offset the effects of asymmetric shocks. In addition to a common budget for stabilisation purposes, there would be automatic stabilisers financed at EU level, for example to finance a common unemployment benefit scheme.

4) Coordination of economy policies, that is, the avoidance of excessive macroeconomic imbalances, including the elimination of both the excessive deficit and surplus of the balance of payments. The author proposes to pursue an expansive wage policy in countries with a balance-of-payments surplus in order to terminate imbalances. The above reforms would efficiently support the functioning of the euro zone, while at the same time, they require a significant step towards deepening the European integration. Moreover, they would lead to higher burdens on creditor countries, which presumably would not gain support from these countries. Germany explicitly stated several times that the EU is not a transfer union; however, without the reforms outlined above, this "muddling through" the crisis will only continue. Even a smooth divorce may be better than that.

In the case of a *smooth divorce*, the euro zone could be divided into one or more sub-areas. These sub-areas would constitute a more homogeneous currency area where a centralised monetary policy can set an interest rate level appropriate for the Member States. Under this scenario, the establishment of 2–3 country groups could be sufficient for the operation of the system. If Southern countries exited form the euro zone, their exchange rates would be lower, and their balances of payments could reach equilibrium. The simplest case, however, could be the exit of Germany, because then the German currency to be introduced would strengthen,

and Germany's balance-of-payments surplus as well as balance-of-payments deficits of the euro zone countries would be mitigated without any shock. However, a smooth divorce can widely be considered as politically unacceptable, and may restrain the already scant support for the European integration efforts for decades to come.

In the case of establishing a *flexible euro zone*, Member States could maintain their exchanges rates within a narrow band, and in parallel with the deepening of integration, these bands could be narrowed. In this approach, it would be reasonable to introduce export coupons in order to regulate the export quotas of companies. In this way, the development of the balances of payments could be directly regulated, which would not result in a much stronger limiting factor than pegged exchanges rates. On the whole, a system like this could efficiently combine the advantages arising from the more stable exchange rates, while it would open the door to the still required shifts in exchange rates. As a result, capital flows between Member States could be prevented, and it would be possible to set up an institutional framework that promotes the harmonious development of the euro zone.

Finally, Stiglitz emphasises that the EU is more than a monetary union: hence, whichever alternative is adopted, it will be better than an approach that paralyses the continent and entrenches an approach of "muddling through". To succeed, it should be made possible for each Member State to achieve harmonious growth and full employment, while working to reduce inequalities and improve social justice. At the same time, Member States should avoid establishing economic integration without prior political agreements, which would only result in inoperable structures and painful corrections.

A World Without Jobs*

Kitti Vajda

Martin Ford:
Rise of the Robots: Technology and the Threat of a Jobless Future
Basic Books, September 2018, p. 352
ISBN: 978-0465059997

Martin Ford is a futurist writer focusing on the development of information technology (IT), artificial intelligence and robotics as well as their impacts on economy and society. The core theme examined in his books is automation and a potential increase in unemployment. The author's popularity is indicated by the fact that he is a frequent speaker on the above topics at corporate, scientific and governmental events and conferences.

His book "Rise of the Robots: Technology and the Threat of a Jobless Future" states that robotisation differs from the industrial revolutions of previous centuries in that, due to artificial intelligence, today it threatens even the middle class and the service sector. Information technology is not the only factor that shapes the future. It is inextricably linked to a wide range of social and environmental challenges such as the ageing population, climate change and the depletion of natural resources. In his book, Ford wants to clarify whether IT is really leading us to a turning point which will have the impact of significantly decreasing the demand for labour. In his opinion, this process will probably not take place in a consistent or predictable way. The key message of the book is explained in several short stories.

In the Unites States, the symbiotic relationship between increasing productivity and rising wages began to weaken in the 1970s. Income inequalities increased to a very high level and the labour share of the national income gradually decreased. The US economy entered a new era, in which a fundamental shift in the relationship between workers and machines constituted a decisive element. The fundamental question is, of course, how the accelerating technological development will transform existing systems, what changes it will bring, what areas and jobs it will affect and how it will influence existing training structures. In his book Ford underlines that Artificial Intelligence will impact the agricultural and services sector,

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Kitti Vajda is Protocol and Event Coordinator at the Magyar Nemzeti Bank. E-mail: vajdak@mnb.hu

and it may force trained professionals out of the labour market. Furthermore, it will also transform the higher education system.

It is worth stressing the importance of the impacts on the service sector, since in both the United States and the developed economies, the services sector will be hit the hardest: this is the sector in which the vast majority of employees currently work. The expected future trend is already apparent today from the emergence of ATMs and other self-service terminals, but robots from a San Francisco company called Momentum Machines producing 360 hamburgers per hour also prove the expansion of automation. According to general estimates, an average fast-food restaurant spends approximately USD 135,000 a year on the wages of fast-food workers, so recouping the costs of these new robots can be done in the span of just one year.

The agricultural sector has already witnessed the most dramatic changes: plants such as wheat, maize or cotton can be planted, grown and harvested mechanically, and thus human labour in developed countries decreased significantly in this field. Automated technology became necessary for keeping farm animals, too. Highly developed agricultural robots are definitely attractive to countries that have no access to cheap foreign labour.

These developments also impact the jobs of skilled workers who may be forced out of the market, as their work may involve routine, predictable tasks that can be performed by machines or robots. The author believes that this process is accelerating. There are already robots that create media content, news, commentaries and to compose music. Thus, the question arises as to what heights of creativity and productive abilities are actually unique to human beings.

Obviously, all of these labour market developments require the transformation of the higher education system. The so-called MOOC (Massive Open Online Courses) phenomenon already broke into public awareness in 2011, and through the Internet, anyone from the age of 10 can learn the basics of artificial intelligence from the most prominent researchers in the field. It seems that a new era began with these online courses where elite training is available for everybody either free or at low cost. Higher education is one of the key areas in the US which has been immune from the impact of the increasingly rapid developments in digital technology. However, the emergence of MOOCs, automated marking algorithms and adaptive learning systems have opened up promising development potential for the higher education sector, expanding the dimensions of personal development, too.

IT has become a real universal technology which will make itself widely felt. It is expected to have an impact on every existing industry, and therefore demand for labour will decrease with the integration of new technologies into business models.

However, there are economists who reject this concept, basing their argument on the comparative advantage, a classic theory of economics. Throughout history, the principle of comparative advantage has always been a driving force behind specialisation and trade between individuals and nations. However, machines – especially software – can easily be copied. Therefore, in the age of intelligent machines, it would be necessary to reconsider the theory of comparative advantage. If we think exclusively in terms of persons, the cloning of an employee with the ability to perform his duties into a "troop" of workers with the same knowledge and experience would definitely be an interesting solution for large corporations. In an age when intelligence is becoming tangible in the area of information technology, the relationship between people and machines is being completely redefined. These changes will then increase productivity to different extents in the various enterprises and industries, at the expense of the labour force used.

On the whole, the main question of the book is whether accelerating technological development will be able to change the existing system to such an extent that we will have no other option but to fundamentally restructure it. Experts have different opinions: some see an opportunity in the scenario that machines will improve human intelligence and may increase lifespan, while others worry that machines will "take over power".

In Ford's opinion, robots can perform many types of tasks, such as the activities of lawyers as well as financial services. He is sure that there will come a time when robots perform every kind of work, almost without exception. Today, robots are being primarily used in industrial establishments and the mechanical engineering sector, but progress is constant, and thus robots may appear in many other fields, e.g. in taking care of the sick and elderly or in customer services. The author also highlights the fact that the 21st century has practically not created even a single job, but a number of jobs have disappeared. This may lead to a decrease in employment and a dramatic change in the economic situation. In an extreme case, to a world where robots taking over the jobs of people will ultimately manufacture goods for the rich.

In the author's opinion, the biggest problem is that for a long time the growth rate of jobs has not been able to keep pace with the development of technology. According to Ford, countries are not responsive to radical concepts, but if robots create a situation in which human labour is not competitive with them, labour's share in the gross national product will fall to a minimum. Because a robot is nothing else but capital converted into labour force, and if robots replace human labour, the employees' share of the gross national product may approximate zero. If we reach this situation, the question arises: Who will buy the products that robots make?

Report on the Sessions of the Finance, Competitiveness and Responsible Corporate Governance Sections of the Annual Congress of the Hungarian Economic Association in 2018*

Ferenc Tóth – András Zsolt Szabics – Gábor Szarka

The annual congress of the Hungarian Economic Association (HEA), an organisation with a history spanning back 124 years, was held between 6 and 8 September 2018 for the 56th time, this time in Debrecen. This conference is the one of the most traditional meetings and at the same time the largest conference of the community of economists. A record number of participants, about nine hundred persons, attended the annual congress, and in addition to the opening and plenary meeting a total of 19 section meetings were held. The first two plenary lectures of the event were held by *György Matolcsy*, Governor of the Magyar Nemzeti Bank (MNB), and *László Palkovics,* Minister of the Ministry of Innovation and Technology. It made the event especially relevant that the large investment project of BMW in Debrecen exceeding 1 billion euros was announced one month prior to the roaming conference. In this report, we cover the section meetings of the Finance, the Competitiveness and the Responsible Corporate Governance Sections.

Usually, the meeting of the Finance Section is one of the most important and most well-attended section meetings of the annual congress. This time again, it delivered interesting, exciting and vigorous debates, and the deputy governors and executives of the MNB had panel discussions on the following four major topics with banks' top managers, major actors of the financial and real estate sectors:

1. The biggest challenges faced by the banking system

2. Current issues of the housing market and home creation

3. The subject of self-care

4. Current issues in the fintech sector

---

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Ferenc Tóth is an Advisor to the Executive Director at the Magyar Nemzeti Bank. E-mail: tothf@mnb.hu
András Zsolt Szabics is an Analyst at the Magyar Nemzeti Bank. E-mail: szabicsa@mnb.hu
Gábor Szarka is Professional Secretary to the CEO of Budapest Stock Exchange (BSE). E-mail: SzarkaG@BSE.HU

In the first part of the morning meeting, *Márton Nagy*, chairman of the meeting, Deputy Governor of the MNB and chairman of the Finance Section of HEA, asked *Éva Hegedüs* (Gránit Bank), *Radovan Jelasity* (Erste Bank), *György Zolnai* (Raiffeisen Bank), *Ádám Balog* (MKB Bank) and *László Bencsik* (OTP Bank) about *the major challenges facing the banking system.*

Commercial banks mentioned low profitability among the greatest challenges and a major risk faced by banking system in the next few years, caused by several factors including high and increasing capital requirements, regulatory buffers, the costs of deposit and investment protection, the low net interest margin and the taxes imposed on the sector. Important issues include cybersecurity, cost and operating efficiency and technological developments, since the major technological challenges are focused in the digital space. This is also a regulatory task. One big question is how society can be motivated to take advantage of the technological opportunities and learn to use the digital opportunities. One of the banks' top managers highlighted adaptation to economic cycles: since he anticipates a global recession within two years, partly owing to the effects of the Sino-American trade war, a shock- and crisis-resistant portfolio needs to be built up. It is also necessary to adapt to changing consumer needs. In addition, for human resources it is a serious problem that – owing to the tight labour force – the banks attract IT professionals from one another. Implementation of the instant payment system to be started next year also poses a challenge for the banking sector.

After that, concerning housing loans it was said that households now use credit for about 45 per cent of housing purchases. People learned a lot from the crisis, and they are aware of the difference between loans with fixed interest rates and ones with variable interest rates, but in reality they are only starting to become familiar with interest rate risks, and therefore it is the shared responsibility of the banks and the regulatory authority as to what direction they orient borrowers. Owing to the encouraging actions of the MNB, the average spread of housing loans with fixed interest rates has decreased, and more and more borrowers are taking out housing loans with an interest rate which is fixed for a longer term. The penetration of loans with fixed interest rates in the placement of new loans shows that now customers understand that over the longer term they are better off if their monthly instalments are more predictable. However, in the case of loans with variable interest rates borrowed earlier, it is not easy to make it understood by retail customers that they should switch to loans with fixed interest rates involving the payment of higher monthly instalments. The healthy and persistent maintenance of the new credit cycle is a priority matter of financial stability. One element of this is a stable real estate market, with long-term housing loans available with fixed interest rates.

The next topic of the first part of the section was lending to SMEs, which has been growing dynamically. At some banks, the annual growth rate of the loan portfolio is

about 20 per cent. The Funding for Growth Scheme substantially restructured the portfolio of SME loans – with long maturity and fixed interest rates – but since then not many loans of this type have been extended. Banks make efforts to lend with fixed interest rates in the case of corporate loans, however there are banks that experience difficulties in obtaining the required long-term resources. In corporate loans, the period of return on an investment is often 4 or 5 years, and they adapt the maturity of the loans to that.

After that, Márton Nagy, Deputy Governor of the MNB, brought up the issue that in Hungary, in parallel with the tightening of the balance sheet of the central bank, the ratio of the cash stock has risen to a high level, the second highest in the region, and it is much larger than in the developed Scandinavian countries. In the opinion of the Deputy Governor of the MNB, this huge cash stock should be channelled back into the funding of the economy. If half of this portfolio comprising about 5,800 billion forints was invested in government securities, this could replace the Hungarian government securities portfolio held by foreigners. The high level of cash use is a hotbed for the grey and black economy, and the banking system also supports the reduction of the cash stock, since it is much more costly than scriptural money. According to the executives of the commercial banks, factors that contributed to the emergence of this high stock include the lower interbank interest rate and thus the low deposit interest rates, the duty on financial transactions and the opportunity to withdraw cash free of charge up to 150,000 forints. One step in the right direction is the new rule to take effect from next year that will make bank transfers transaction duty-free under a value of HUF 20,000, which may ease the present situation.

As the last topic of the first part, the number of banks was discussed, which is high in Hungary in an international comparison. Incidentally, this phenomenon is known all over Europe, the European Central Bank is also dissatisfied because after the crisis the European banking market did not undergo a consolidation and ten years has been wasted. The MNB promoted consolidation, but it did not materialise, and no major merger and bank fusions took place. In their responses, the managers of the commercial banks indicated that one can only buy what is up for sale. There were attempts, but the selling owners backed off. They perceive the real problem in that there are nine universal banks with national network operatings in Hungary. In addition, a bank merger is a very complex task. Purchasing a portfolio is much simpler than that and can work in practice as well. The difficulty of planning technical development and the changing vision of the future of the banking sector also impede consolidation. Perhaps, actual consolidation will only take place after another crisis. The branch networks keep shrinking, but there are still too many branches. In the opinion of the MNB, profitability could be improved in this field, as well. The banks were divided in their opinions on this matter, and in many places financial advisory services continue to be provided in the branch offices.

The current issues in relation to the housing market and home creation were put up for discussion in the second block, moderated by *Gergely Fábián,* Executive Director at the MNB responsible for the analysis of the financial system and for lending incentives. The expert participants of this section were *András Becsei,* Vice-President of the Hungarian Banking Association, *Tibor Földi,* Chief Executive Officer of Cordia Zrt., *Gábor Kiss,* Managing Director of Metrodom Kivitelező Kft. and *László Harmati*, Deputy CEO of ERSTE Bank Zrt.

Most of the new home construction projects in Budapest are slated for completion before 2020, but many projects are delayed, partly because the output of the construction industry is reduced by the significant shortage of labour, even though it has been decided that the VAT rate on newly built homes will be restored to 27 per cent from 2020. This could significantly set back the construction of new homes, although new projects have appeared the completion of which is expected after 2020. It was stated by the bank managers that the reserves in the lending resources of the banks certainly cover the additional needs to be generated by the raise of the VAT on new homes. The role of financing provided by banks has been gradually increasing in the housing market. The Hungarian Banking Association noted that it had started discussions with the Financial Ministry on what should be considered an advance payment in the market of new homes, so that banks should be able to finance home purchases safely, and that the government should introduce transitional measures to mitigate the problems arising from the uncertainties about the housing projects in progress. Interest rate fixation has been increasingly common in new housing loans: in the first half of 2018, 77.5 per cent of the contracts on new homes involved interest rate fixation at least for a term beyond one year, however, approximately 60 per cent of the existing housing loan portfolio still has variable interest rates, which represents a risk.

Many people would like to move into a new home, but in Hungary this is still considered a luxury. Since the beginning of 2014 housing prices have doubled in the capital, but even in the countryside, prices have been increasing steeply. As a result of the 27 per cent VAT, from 2020 the square meter prices of new homes in Budapest could exceed 1 million forints. In Budapest, since 2014 investment has been the primary motivation for home buying, to a large extent because of the low interest rate environment. Another grave problem is that the renewal rate of the domestic housing stock is very low in regional comparison, and the condition of a significant part of homes is poor, especially in terms of energy use, and the number of renovations is low.

In the first afternoon meeting in the section, moderated by *Csaba Kandrács*, Executive Director of the MNB in charge of the supervision of financial institutions, the participants discussed aspects of self-care. The panel consisted of *Anett Pandurics*, President of the Association of Hungarian Insurance Companies, Chair-Chief Executive

Officer of Magyar Posta Biztosító Zrt., *Mihály Erdős*, Chair-Chief Executive Officer of Generali Biztosító Zrt., *Ilona Hardy*, founding Chair of Aranykor Voluntary Pension Fund, *István Máté-Tóth*, Deputy CEO of the Budapest Stock Exchange, and *István Horváth*, Head of the Private Banking Directorate of K&H Bank Zrt.

In Hungary, the ratio of products supporting long-term self-care is low, and an increase in the ratio of savings targeting self-care would be socially desirable. The market actors expect a stronger involvement by the state, in order to enable self-care savings and the development of the stock exchange to support each other mutually. The ratio of government securities is the highest in the life insurance schemes and the voluntary pension funds, the ratio of investment funds is also significant, but only 1.2 and 3 per cent of these funds are invested in domestic shares, respectively. According to the market, one of the reasons is the low level of domestic equity offering. At present, in Hungary life insurers and pension funds typically offer portfolios of fixed composition to most of their customers interested in savings. Higher yields could be accomplished by more active portfolio management, which would also make the recruitment of new members easier. It would go a long way towards the promotion of self-care if the financial literacy and risk appetite of the investors increased, because the mentality of the average Hungarian investor is primarily risk-averse. The approach of Hungarian investors to time also needs to be improved: 3 to 5 years is now considered very long, and for young investors even 2 or 3 years is too long. The membership of the fund sector is ageing, the distribution of members by age shows that the age group of 20 to 30 year-olds is a missing generation. The amendment of the rules on cafeteria is expected to reduce the ratio of employer's contribution. It is important to maintain a predictable regulatory environment and to make asset management more cost efficient.

Over recent years, wages have increased significantly in Hungary. In that context, it was mentioned that, according to the MNB's publication entitled "10-year vision of the future of the insurance sector in 7 points", to achieve the penetration target (3 per cent) average annual growth of 8 per cent would be needed over the next 10 years, but the insurers are pessimistic and only anticipate growth of 3.7 per cent.

The programme of the Finance Section was concluded by a panel discussion on current developments in the fintech sector, moderated by *Péter Fáykiss*, Director of the Macroprudential Directorate of the MNB. Participants of the panel included *László Windisch*, Deputy Governor of the MNB, Member of the Board of the Responsible Corporate Governance Section of HEA, *Gábor Strén*, Account Director of Microsoft Hungary, *Gábor Lemák*, Fintech Strategist of FinTech Group, *Levente Jánoskuti*, Managing Partner of McKinsey, and *Balázs Bíró,* Partner of Deloitte Hungary, Head of the Financial Consulting Division.

The panel discussion began with a vote of the audience performed by smartphones on matters concerning the role of digital transformation and its relationship with profitability. In respect of the current issues of the fintech sector, it has been stated that the exploitation of the opportunity of fintech could improve cost efficiency, and the global income arising from Big Data is expected to increase further. The digital transition is a complex task that affects several fields, and it should be in sync with internal transformation, and a cultural transformation is also needed. The banks could benefit the most from PSD2 (the payment services directive) and related to that, the utilisation of the data assets of banks, if they are open enough and take a creative approach to the challenge. Every bank sees a promising opportunity in PSD2, but the necessary IT development needs pose a very serious challenge. So far, the MNB has held coordination talks with 10 to 15 market actors which are interested in Account Information Service Provider (AISP) service.

The Deputy Governor of the MNB explained that there was no way to know exactly what the actual meaning would be in 5 or 10 years of what we call fintech or technological change today, and what kind of cultural changes will be triggered by it. However, it is known at this point that digitisation and data management and processing will be the domains where development will occur, and the MNB intends to become a pioneer in these fields. Therefore, the MNB has already developed its own fintech laboratory and regulatory testing environment (Sandbox), and is embarking on significant digital investments, since the digital development will also renew supervision. He stressed that this new type of sector should be supervised by a new type of supervisory toolset, and that the Supervisory Authority will also apply artificial intelligence and blockchain technology. Machine learning is intended to be used by the MNB for the processing of the huge volume of incoming information, and blockchain for monitoring home insurance policies concluded for properties underlying the mortgage loans.

The Competitiveness Section of HEA held its section meeting for the third time this year. The primary aim of this section is to call the attention of economists to the importance of the topic of competitiveness and to its economic and social significance. Similarly to recent years, the section had the opportunity of having a foreign presenter this year as well, in the person of *Martin Kern*, Acting Director of the European Institute of Innovation and Technology (EIT). In addition to the various points of view, the presenters concurred that Hungary has one option to avoid the middle income trap, and it is to increase the competitiveness of the economy.

In his lecture, Mr Kern presented in detail the model that has been built up and followed by the institution, the purpose of which is the promotion of innovation and competitiveness all over Europe. In his presentation, he expressed his appreciation for the city of Debrecen which in recent years has been able to take a significant step towards improving competitiveness, which was reflected later on in winning

the BMW investment as well. According to Mr Kern, it is a misconception that there is no way to impact the processes of innovation. It is possible to influence and improve innovation as well, but this requires the cooperation of many actors and for a sufficiently long period of time, in order to develop a well-operating innovation ecosystem. Having realised that, EIT has developed innovation communities throughout Europe where the business sector, educational institutions and research institutions develop the innovation ecosystem while helping one another. The EIT also assigns resources to the various aims, in the Union budgetary cycle between 2014 and 2020 they have a budget of 2.4 billion euros. During their history, companies participating in their programmes have enabled the creation of 6,100 highly-qualified jobs. The presenter also mentioned such Hungarian success stories as OptoForce, Powerwhale and imagiCase.

In his lecture, Mr *László Papp,* Mayor of Debrecen, presented the urban and economic development concept that has played a crucial role in the decision of BMW in favour of the city for the construction of its new factory. Almost two decades ago the city stood at a crossroads: the area, considered a backwards region in the European Union, had no other option than making a move towards industries of high quality and value added. The development of the local infrastructure was a special priority, between 1998 and 2014 the transport network was established that is a real match for that of Budapest. Local education is traditionally a strong point of the city, Debrecen is home to one of the largest universities of the country, among others. In the city of 210,000, the ratio of students is about 30 per cent. Given this background, when the development strategy was implemented, the renewal of education was one of the focus points. Mr Papp highlighted the existing Vocational Training Centre of Debrecen, the main mission of which is to increase the number of students in vocational schools by 30 per cent annually. Going beyond that, for example, it was an important aspect in the decision on the BMW project that the city should have an educational institution that is capable of providing a high level of education also in a foreign language, from kindergarten until the end of the secondary school: this function is fulfilled by the International School of Debrecen.

According to the Mayor, a professionally operating, well-organised background mechanism is essential for any good economic development strategy (such as the first Phoenix Plan). After the rationalisation of the development activity, the non-profit enterprise 'EDC Debrecen' was established, which focused on the management of liaising with foreign investors, as well as on SME and urban development. The application of local incentives makes the city even more attractive, which is one of the reasons why a fund of 2 billion forints was created for companies intending to set up a site in the city. The local airport is expected to stimulate a dynamic increase, and several infrastructure projects are in progress

under the New Phoenix Plan of 200 billion forints. The investments reported between 2016 and 2018 in a total value of over HUF 500 billion confirm the viability of the concept and may serve as a model to follow by other Hungarian cities as well, added Mr Papp.

Dániel Palotai, Chief Economist and Executive Director of the Magyar Nemzeti Bank, presented the 180 points recommended by the MNB for the improvement of competitiveness. In 2016, the central bank started to deal with competitiveness in more depth at the request of the Government, the first two major milestones of which was the monograph titled Competitiveness and Growth, and the Competitiveness Report, which was first published in 2017. It was a continuation of this workshop that the collection of proposals of the central bank consisting of 180 points was created in 2018, with the aim of signposting a roadmap to sustainable convergence for Hungary. According to Mr Palotai, Hungary needs to move onto a knowledge and capital intensive trajectory of growth based on a turnaround in competitiveness. According to the Chief Economist of the central bank, with the reform actions formulated, it is a feasible aim to approach the level of development of Austria in just more than a decade.

Detailing the proposed actions, he said that in the new financial model resources should be provided in a manner adapted to the life cycles of companies, by a financial intermediary system that is more competitive and better meets demands for loans. He pointed out that the productivity of Hungarian undertakings is significantly lower than the level of competitors operating in the western and northern parts of Europe. The shortfall is especially high in the SME sector, which essentially needs innovation and an increase in foreign trade activity to overcome the lag, and economies of scale must also be exploited. An active labour market and wage policy are of crucial significance, which is compatible, among others, with the continuation of the reduction of taxes on labour. However, in the tight, mobile international labour market, a cheap labour force is more of a disadvantage than an advantage in terms of competitiveness. The robust economic growth necessary for convergence can be accomplished through durable increases in wages, for which it is essential to increase productivity. In addition, sustainable convergence is impossible without an efficient state, and therefore the rationalisation of bureaucracy and the acceleration and digitisation of processes are absolutely necessary. At the end of his lecture, the Chief Economist of MNB said that Hungary also needed a demographic reversal, high quality education and the growth of the number of years spent in good health for successful convergence.

Mr *Gábor Balázs Veress* from the General Department of Competitiveness of the Ministry of Finance started his lecture with a presentation on how competitiveness is measured internationally. Each of the WEF, the IMD, the World Bank and the German-Hungarian Chamber of Commerce and Industry applies a different

methodology to measure competitiveness. In the compression of the data, the lack of transparency and representativeness, the use of subjective surveys and the arbitrary nature of the weighting raise problems. Typically, Hungary is in the middle of the list, but there are promising signs and good examples, such as Debrecen. In its 2017 publication on the competitiveness of cities, the World Bank ranks Debrecen the first of 22 cities, and it ranked highly in other areas as well.

In his opinion, the establishment of the Competitiveness Council also indicates that a turnaround in competitiveness could take place in Hungary. In the ministries efforts aimed to promote competitiveness are under way, such as the development of electronic services in public administration. Work is in progress at the tax authority and the financial ministry as well, to enable enterprises to process their tax reports much faster, on the model of the e-szja (electronic personal income tax). According to Mr Veress, undertakings can anticipate a great step forward within 1 or 2 years.

He also highlighted that an increase in productivity is the key to improve productivity. Progress has been made on several fronts: thus, as a result of the economic policy decisions of recent years, a labour-and investor-friendly environment has been established, and investor satisfaction has improved, which provides a good basis for continuing these efforts. Despite that, the country needs to address several challenges. He is of the opinion that tax administration should be reduced, the entire financial infrastructure should be developed, and furthermore, the potential for innovation and the quality of public administration services should be improved.

Magdolna Csath, Member of the Competitiveness Council, presented the soft factors of competitiveness and their situation in Hungary, from an international perspective. At a lower level of development, competitiveness is shaped by the so-called hard factors, such as low taxes or flexible labour market, because these factors enable the appearance in the economy of those elements of the value chain that are less knowledge-intensive. However, in time these hard factors prove to be insufficient, and therefore focus shifts to soft factors, such as knowledge, the spread of entrepreneurship and increasing resilience to crises, as well as strengthening social capital and the level of trust. According to Ms Csath, trust is the new currency in the world (and not only data, as others claim). The sharper focus on soft factors is especially important in a world where robotisation and the rapid transformation of artificial intelligence could bring about changes in the structure of the economy, according to the member of the Competitiveness Council. Social, demographic and ecological sustainability are important elements of a competitiveness model ensuring sustainable competitiveness, in addition to economic sustainability. This also means a shift from a quantitative to the qualitative approach, and from short-term thinking to longer-term thinking in terms of how competitiveness is

understood. Hungary is lagging behind in this field: for example, Hungary is in a good position in terms of human capital capabilities, but not in such a good position in terms of the development and efficient exploitation of human capital.

She noted that the productivity of the domestic SME sector is indeed lower, but the productivity of domestic large corporations also lags behind their international competitors. And when the smallest companies are assessed, not only aspects of efficiency should be considered, but also, for instance, their role in shaping the quality of life of the respective communities. Carrying on this train of thought, GDP as the central benchmark of development could also be challenged. According to Ms Csath, affluence and well-being are two different concepts, and therefore in addition to or instead of increasing GDP, one could also define such targets as increasing the number of years spent in good health.

*Zsombor Esső*sy, President of the Hungarians in the Market Club, held the closing presentation of the competitiveness section. At the beginning of his lecture, he mentioned that within the space of a few years the general mindset regarding competitiveness has changed. He approved that now the focus is on innovation, increasing the productivity of the entire corporate sector and the development of human capital. He noted that it is essential for Hungarian enterprises to exploit the opportunities offered by the 4th Industrial Revolution. In the opinion of Mr Esső*s*y, the biggest impediment to this is that the productivity and innovative capability of Hungarian enterprises are low in international comparison.

In the opinion of the President of the Hungarians in the Market Club, Industry 4.0 is changing our entire lives, and therefore holistic thinking is recommended, but we should not think in terms of renewing only one particular area, in isolation. Education, training and attitude-shaping should be considered an integral part of the strategy, since today in many cases students should acquire professions that do not even exist as yet. He especially highlighted economic flexibility, which could become very significant in the future, for reasons that include the fast changes in consumer preferences.

The Responsible Corporate Governance Section represented itself as a standalone section for the second time. This year the invited presenters and professionals discussed two different topics: one was Brexit and the related geopolitical, economic risks, while the other was about practical aspects of responsible corporate governance.

The Brexit panel kicked off with the introductory presentation of Mr *Gary Campkin.* Mr Campkin is the Head of London-based TheCityUK independent interest representation group. The significance of the financial industry is clearly shown by the fact that it is responsible for approximately 10 per cent of the total GDP of

Great Britain, employs about 2.3 million people and contributes to exports by an amount exceeding GBP 68 billion, it is also the largest contributor to the budget. In fact, London is the most important financial centre in the world. Currently. The Brexit referendum resulted in a clear decision: the United Kingdom is going to leave the European Union in 2019. Mr Campkin emphasised in his lecture that the country will leave the EU, but not Europe. However, the challenges affecting the financial sector are nothing new, and the exit will only strengthen them. What are these challenges?

- How can London retain its role as a global financial centre?
- How can the industry address the effects of digitisation?
- The increasing role of FinTech/RegTech/LawTech
- Green finances
- Cybercrime
- The personnel environment of the industry: recruitment, training and retention of staff
- Changes in the image of the industry

Solutions to these challenges should be found together with the stakeholders (such as the government, the industry, the general public). The aim is to preserve continuity after Brexit as well, so that the transition is smooth in terms of fulfilling existing contracts and commitments. None of the parties is interested in a "no deal Brexit", so this continuity will survive in some way.

Finally, he highlighted three challenges concerning the European Union after Brexit: 1) The departure of the United Kingdom will leave the capital market of the European Union much weaker, 2) New trade agreements are necessary, 3) The United Kingdom was a strong influencer of opinions in the European Union. The country's exit will result in the establishment of new groups, and the Visegrád countries also need to find their place in this new constellation of forces.

The panel discussion that followed the introductory presentation was moderated by *István Máté-Tóth*, Deputy CEO of the Budapest Stock Exchange, who first asked the participants what could be the outcome of the negotiations. *Noémi Holecz*, Senior Analyst at Equilor, highlighted the integrated nature of corporate value chains, mentioning Airbus as an example: it is not possible to remove by a political decision any single element of the production process that extends through a long value chain. At the same time, the EU is interested in imposing worse conditions on

a departing country than those applicable to the remaining members, and therefore the rights of the Britons will be reduced, regardless of the manner of the exit.

Ákos Kuti, Senior Analyst at MKB Bank, noted that for the last two years the negotiations have not progressed at all and very few decisions have been made. At present, any of the outcomes is equally likely to happen. Uncertainty makes it more difficult for corporate managers to make long-term decisions. This uncertainty is compounded by the slowdown in growth and the closing of the output gap in the European Union, and therefore Brexit carries significant risks.

According to *István Madár*, Lead Analyst at Portfolio.hu, in an economic sense everyone would be interested in close cooperation between the EU and the United Kingdom, but the EU intends to send the messages that it will not support cherry-picking and non-membership in the EU should be subject to worse conditions. There are conflicts within the UK government as well concerning the negotiating strategy. The dividing line will be probably between "no deal" and "hard Brexit": any scenario could happen.

The second question was about the various interests of the City, the United Kingdom and the EU and the possible ways to align these. Gary Campkin noted that no significant decision is ever made without a crisis. An agreement will be reached and neither party is interested in a "no deal" scenario. This time, the agreement is different from the earlier ones in that it is not aimed at convergence, but rather at the management of divergence. The UK has always represented pronounced opinions in the great debates of the EU, the remaining EU members will find it a challenge to strengthen their own voices.

Ákos Kuti highlighted the impacts of conflicts: on the one hand, the US-China customs war has already had a tangible impact on the pricing of certain products in import substituting products as well, Brexit could bring about a higher price level. On the other hand, these processes could rearrange supplier chains as well, transactions could slow down, which could restrict growth.

Ms Noémi Holecz noted in her contribution that businesses adapt to the circumstances in every situation. At present, London is the financial centre of the world, which is enabled, to a not insignificant extent by the fact that it provides access to the European markets applying more permissive rules than those of the EU. This will cease with the loss of the so-called "passporting" right and the single centre may be replaced by a fragmented array of new, smaller centres.

István Madár noted that Brexit directly affects our region to a small extent only, but in an indirect manner it still impacts us by creating growth-reducing effects on the EU. Considering all of the risks affecting the world, at present the crisis of

especially vulnerable countries (Turkey, Argentina) and the vulnerability of Italy are more significant than Brexit.

The second panel was titled "Responsible corporate management in practice". As the first presenter, *Balázs Bodzási,* Department Head of Economic Law at Corvinus University of Budapest and President of the Responsible Corporate Management Committee (FTB) of the Budapest Stock Exchange, presented the recent history of responsible corporate management in Hungary and the most important elements of the Recommendations adopted by the FTB this year. The activities of companies listed on the stock exchange may have impacts that go beyond their existence, which is why the need for responsible corporate management has been formulated. Since 2004 the BSE has summarised these principles in its Responsible Corporate Management Recommendations. Companies listed on the BSE submit a report annually based on the "comply or explain" principle. The newly adopted Recommendations affect, among other things, shareholder's rights, the conduct of the general meeting and remuneration, and must be taken into account from 2019.

Attila Chikán Jr., Chief Executive Officer of the company Alteo, presented the importance of responsible corporate management through their own example. Since its launch, the company has consciously prepared itself for being listed on the stock exchange, and for the challenges caused by the resultant higher level of publicity. Being listed on the stock exchange enables more transparent operation, for which the Recommendations provide appropriate support.

As the third presenter, *Ákos Lukács*, Senior Manager at Deloitte in charge of sustainability and climate change, presented the increasing role of this line of business. Environmental aspects play an increasing role in policymaking, the effects of these must be included in the business decisions of companies as well. For example, in the budget of the EU for 2021 to 2027, 40 per cent of the costs of the Structural Fund, Cohesion Fund of that time will be aimed at climate proof, which will thus open up development areas and markets.

The panel discussion that followed the lectures was moderated by *Balázs Bozsik,* Sales and Marketing Director at the BSE, who asked the presenters about the role of stock exchanges in responsible corporate management. Concerning the matter, Mr Bodzási highlighted the current problem of generational turnover, which may be resolved by the institution of fiduciary asset management and by the stock market.

Attila Chikán Jr. highlighted the long-term approach of listed corporations and company building, which may provide a solution to the agent-client problem existing between the owner and their manager, for the management of conflicts of interest. Alteo anticipated becoming a listed company in 2008, at the time of its establishment already, which provides excellent long-term funding for a rapidly

growing company. A listed company is being exposed to higher publicity, which incurs higher initial costs, but over time these costs are recouped through reduced employee turnover and the reduction risk premiums. The management needs to be more disciplined because of the regular reporting obligations.

Ákos Lukács pointed out that sustainability is about the accomplishment of long-term objectives, however, action must be taken today. Long-term aims may be included in the core business activity by conscious regulation.

Zsombor Essősy, President of the Hungarians in the Market Club, also mentioned that being listed on the stock market would mean a significant jump between levels for smaller companies, which would also be important because the performance of smaller Hungarian family-owned companies depends solely on the founding owner, which is reflected by the deteriorating profitability of these companies.

Richárd Végh, Chairman-Chief Executive Officer of Budapest Stock Exchange, also emphasised in his contribution that every company should already set the target of becoming eligible for the stock exchange at the time of establishment. The significance of stock exchange Recommendations is that as long as the manager of the company is also the owner, it is easy to observe the rules that I have made myself, but when there are several thousand owners, the operating principles must be set forth in writing. In the Budapest Stock Exchange two-third of the investors are foreigners, which is proof that they have trust in Hungarian companies. Therefore, regardless of being listed in the Hungarian stock exchange, it is important for every company to implement regulated operating conditions and manage the stakeholders. Therefore, the responsible principles of corporate management facilitate the sustainable development of companies, and are essential above a certain size.

INSTRUCTION FOR AUTHORS

Manuscripts should be submitted in accordance with the following rules.

- The length of the manuscripts should be limited to 40,000 characters (including spaces) but a ± 50 per cent deviation is accepted. Manuscripts should be written in Hungarian and/or English.
- Papers always begin with an abstract which should not exceed 800–1,000 characters. In the abstract a brief summary is to be given in which the main hypotheses and points are highlighted.
- At the bottom of the title page a footnote is to be given. The footnote contains every necessary information related to the paper (acknowledgement, relevant information etc.). This is followed by the name of the institution and position the author works at, e-mail address in Hungarian and English.
- Journal of Economic Literature (JEL) classification numbers should be given (three at least).
- Manuscripts should be written in clear, concise and grammatically correct Hungarian and/or English. Chapters and subchapters should be bold.
- Manuscripts should contain the list of references with the first and surname of the authors (in case of non-Hungarians the initials of the first name are required), the year of publication, the exact title of the book, the publisher, the place of publication. In case of papers, the exact title of the journal, the year, the volume, and the pages should be indicated. References in the text should contain the surname and the year separated by comma. When citing, the exact page be indicated.
- Tables and figures are to be numbered continuously (chapters and subchapters should not contain restarted numbering). Every table and figure should have a title and the units of quantitative values are to be indicated. Tables and figures are to be made by MS Word and Excel in Hungarian and English. Notes and sources are to be put directly at the bottom of the tables, figures.
- Equations should be aligned to the right and should be numbered continuously in parenthesis. (Chapters and subchapters should not contain restarted numbering.)
- Manuscripts are to be sent to the Editorial Office of the FER only. Papers are peer-reviewed by two independent and anonymous reviewers.
- Manuscripts should be sent as attachment by e-mail in MS Word file. Figures and tables should be sent in MS Excel file both in Hungarian and English.
- In case of further questions related to the manuscript visit the following website: *http://english.hitelintezetiszemle.hu/letoltes/authors-guide-en-1.pdf*

Thank you!

The Editorial Office of the Financial and Economic Review
H-1054 Budapest, Szabadság tér 9.
Phone: +36-1-428-2600
E-mail: szemle@hitelintezetiszemle.hu

Financial and Economic Review